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EDITORIAL

THE PASSING OF AN ERA

WITH the death of William Mayo, closely following the passing of his brother, the curtain has fallen on an era in American medicine. Many men great in our profession have left the scene during the past two decades. For the most part they were born shortly before or immediately after the Civil War, and in their time saw the greatest changes in medical knowledge and practice since the time of Hippocrates.

Their early years were spent in the horse and buggy school, their later ones in the era of scientific medicine. They lived through the beginnings of aseptic surgery, the introduction of anesthesia; they were in their prime when a specific was discovered for the treatment of syphilis and *x*-rays and radium were introduced as diagnostic and therapeutic agents. They saw radical changes in medical education and enormous enlightenment in standards of medical teaching. Fly-by-night medical schools, existing merely to make money for their owners, were put out of business, and grading and classification of medical schools made possible a new excellence in facilities available and graduates produced.

Medical organizations during this period have knit together the professional group for scientific, social and public purposes. The American College of Physicians and the American College of Surgeons, the specialty boards certifying qualified practitioners in the various branches of medicine have improved standards in their own fields. Young men are finding it possible to achieve post-graduate training in the United States, without traveling abroad for such work.

William and Charles Mayo in this period founded a great clinic. They were responsible for creating a significant departure in administration, in establishing a functioning diagnostic mechanism based on cooperation, and in developing many new, important and fundamental advances in surgery. The influence on American medicine of their venture and the changes it produced, cannot yet be estimated with any accuracy, for that influence is continuing and spreading throughout the country. Scientific medicine has saved lives; the span of life is greater; each year a new startling development is announced indicating conquest of another natural enemy. Radical and even greater changes are, however, at present awaiting us.

These are troubled times. Once medical meetings were held to hear the well informed discuss scientific subjects. Now many urge that evenings be given over entirely to discussions of medical economics and the social phases of present day

practice. Apparently to many members of the profession these are topics of greater moment than the run of medical developments. We are beset by politicians, economists, reformers, social workers and others—all of whom have programs for the renovation of the present medical set-up. To the doctors it often seems as if they could remodel better to meet the new and changing order if they were abandoned by the social planners, at least for a short time.

We are definitely facing a new era in medicine. Perhaps the organizational work of the Mayos may prove as important in that new era as their scientific and technical contributions did in the one now closing. In the attempt to make medicine meet the needs of a great people, we shall find a place for the best brains among the younger men to pioneer in developing new advances in healing and in extending those advances to all. There undoubtedly are among the youth of today the names which will rank in tomorrow's records with the great names of the old era: Billings, Ochsner, Polak, Murphy, Cragin, Osler, Welch, Coffey and the rest. The Mayos have bridged a great gap. We feel justified in saying—an era in medicine has ended with their death.

T. S. W.

ORIGINAL ARTICLES

TUMEFACTIONS OF THE ABDOMINAL WALL*

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NEW ORLEANS, LOUISIANA

ABDOMINAL wall tumefactions irrespective of size offer considerable difficulty in diagnosis. Their etiology, anatomic origin, histologic character, the differential diagnosis and the prognosis are of concern to the profession in general and to the surgeon in particular.

The relatively small number of abdominal wall masses reported is undoubtedly due to lack of interest or a failure to appreciate the importance of these tumefactions. Whereas MacFarlane[1] of Edinburgh reported a fibrous tumor of the abdominal wall in 1835, and Muller,[2] in 1838, described a similar one which he called a "desmoid" because of its tendinous appearance, it was not until 1864, following the report of a papillary tumor of the ovary in an abdominal wall scar, by Wagner,[3] that apparently there was an increase in the interest in lesions of the abdominal wall, for there were subsequently more reported cases.

The most extensive paper on abdominal wall neoplasms is that of Klot,[4] published in 1921. In this article are reported eight personal cases which are analyzed together with the collected cases of Pfeiffer[5] 300 and Ledderhose[6] (100), all of which were of connective tissue origin.

The incidence of abdominal wall neoplasms is greater than one would commonly suspect. Whereas Gurlts[7] found in 16,637 consecutive neoplasms of all types but thirteen carcinomas and fourteen sarcomas of the abdominal wall, approximately 0.16 per cent, in our ward there were three in 1,460 admissions, or 0.2 per cent. These were 1 per cent of 296 tumefactions admitted over a period of three years. We are reporting forty-one cases of tumor of the abdominal parietes, collected from records of Charity Hospital and Touro Infirmary. Four of these cases were personally observed.†

Because of the lack of any workable classification, we suggest the following which has as its background the etiology of the mass, i.e., congenital, irritational, and neoplastic.

I. Congenital
  A. Benign
    1. Ectodermal
      (a) Dermoids
      (b) Moles
    2. Endodermal
      (a) Omphalomesenteric duct tumors and cysts
      (b) Urachal tumors and cysts
  B. Malignant
    1. Carcinomatous change in the above

II. Irritational
  A. Trauma
    1. Myositis ossificans
    2. Osteoma
    3. Carcinoma, the result of thermal burns or irradiation

† Case from Touro Infirmary not included in statistics.

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4. Hematoma
5. Foreign body (Schlofferis tumor, talcum granuloma)

B. Infection
1. Nonspecific granuloma
2. Syphilis (gumma)
3. Tuberculosis (secondary to abdominal)
4. Parasitic
   (a) Animal (hydatid cyst)
   (b) Vegetable (actinomycosis)

III. Neoplastic

A. Ectodermal
1. Benign
   (a) Papilloma
2. Malignant
   (a) Basal cell carcinoma
   (b) Squamous cell carcinoma
   (c) Melanocarcinoma

B. Mesodermal
1. Benign
   (a) Fibroma (simple, desmoids, keloids)
   (b) Lipoma
   (c) Myoma
   (d) Fibromyoma
   (e) Degeneration forms of the above
   (f) Angiomata
   (g) Neurofibroma
   (h) Osteoma
   (i) Chondroma
2. Malignant
   (a) Fibrosarcoma
   (b) Sarcoma (spindle and round cell)
   (c) Melanosarcoma
   (d) Angiosarcoma
   (e) Endothelioma
   (f) Osteosarcoma

C. Endodermal
1. Benign
   (a) Endometrioma
2. Malignant
   (a) Metastatic carcinoma of the gastrointestinal tract
   (b) Metastatic carcinoma of the genitourinary tract

As will be seen later, many masses are a combination of these. They are either primary in the wall or secondary to pathologic lesions in the abdominal cavity or other primary sites.

In our series, there were sixteen desmoids, three neurofibromas, two spindle cell sarcomas, one round cell sarcoma, two fibrosarcomas, one myxosarcoma, one melanosarcoma, one lipoma, one osteolipoma, one hematoma followed by a fibroma, one hematoma secondarily infected, two nonspecific granulomas, three gummas, one dermoid, and four metastatic malignancies, one each from the stomach, colon, testicle, and gall-bladder. There is no doubt in our minds that there are more cases in the hospital record which we were unable to find, and therefore the comparison to the total admissions or the consecutive admissions of malignancy would be of little value.

In a survey of the literature, it is seen that the most common abdominal wall neoplasm is of mesodermal origin. (Figs. 1 and 2.) The fibromas and fibrosarcomas with their varying microscopic pictures are the predominant type (Table 1) and apparently occur at any age, but most commonly between the ages of 20 and 40. The female is affected six times as frequently as the male (Fig. 2), and the para is more susceptible than the nullipara. (Fig. 3.) Of particular interest are those tumors which occurred in four children under the age of 10. (Table 1.)

The occurrence of abdominal wall neoplasms postpuerperally is a point in favor of traumatic origin, as there is no question that the abdominal musculature is exercised to the point of rupture during labor. In our series, as in Klot's, the relationship of abdominal wall tumors to pregnancy is apparent. The question of trauma as an etiologic factor is controversial as there is no scientific evidence to substantiate traumatotropism.

Desmoids or fibromas of the rectus muscle and its sheath are of particular interest not only because of their higher postpartal

incidence (Fig. 3), and their infrequent occurrence in operative wounds[50,46] (1 in 100,000 operative wounds), but also because complete eradication is necessary to prevent recurrence. In the surgical removal a greater or lesser defect is produced in the fascial sheaths which often necessitates a plastic of considerable proportions. In fact, all local tumors of mesodermal origin must be widely excised because recurrence is not uncommon. (Table II.) In our series there was a recurrence rate of 21.7 per cent.

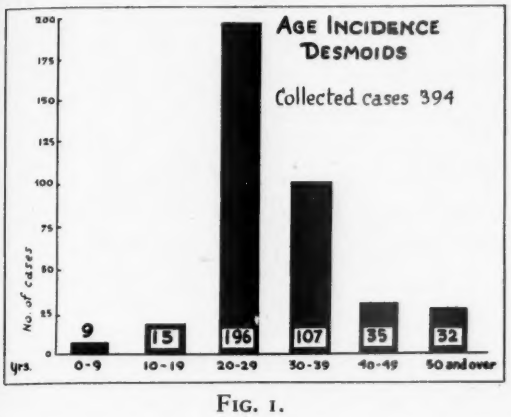

Fig. 1.

vestigation should be made for metastases. In our series, which includes primary and metastatic masses, 22.5 per cent were malignant. (Fig. 6.)

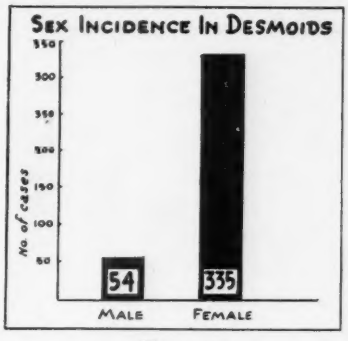

Fig. 2.

Abdominal wall hematomata are particularly difficult to diagnose. They occur most frequently within the rectus sheath. In a review of forty-one cases, Culbertson[10] showed that they usually occurred below and to the left of the umbilicus. They may produce severe or mild symptoms. A hematoma is the one mass in the abdominal wall which may give rise to symptoms of

TABLE I

AGE AND SEX INCIDENCE

	0–10		10–20		20–30		30–40		40–50		Over 50		Unknown	Total
	M	F	M	F	M	F	M	F	M	F	M	F		
Fibroma	1	2	1	3	10	132	4	69	4	10	4	6	34	280
Fibrosarcoma	1	..	..	3	2	21	..	23	2	4	1	3	8	68
Sarcoma	..	3	3	3	5	18	2	7	4	4	3	7	2	61
Myxofibroma	..	..	..	..	..	3	..	1	..	1	..	..	1	6
Myxosarcoma	..	..	..	..	..	...	..	...	..	1	2	..	..	3
Myxoma	..	..	..	..	..	1	..	...	..	..	..	..	..	1
Fibromyxoma	..	..	..	..	..	10	..	6	..	..	..	..	1	17
Fibrolipoma	..	..	..	..	..	...	..	...	..	..	..	2	..	2
Endothelioma	..	..	..	..	..	...	..	...	..	1	..	..	1	2
Angioma	..	..	..	..	..	1	..	...	..	..	..	..	..	1
Angiosarcoma	1	..	..	..	..	...	..	...	..	..	..	..	..	1
	3	5	4	9	17	186	6	106	10	21	10	18	46	442

Whereas only 18.8 per cent of connective tissue neoplasms in all age groups are malignant (Fig. 4), under the age of 20, 48 per cent are malignant. (Fig. 5.) Therefore in the latter age groups thorough insuch severity as to simulate as acute abdomen. In one of our cases, the hematoma became infected and then, although drained, broke through the peritoneum and the patient rapidly succumbed. In another

case, not reported here, seen by one of us (W. H. M.), the hematoma because of its chronicity was considered to be a malig-

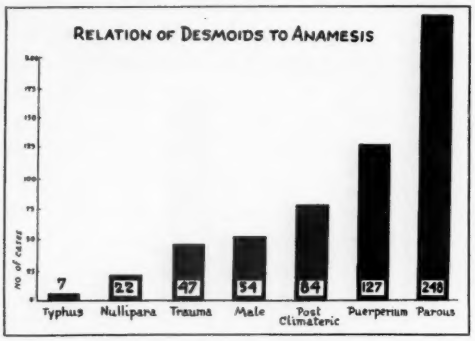

Fig. 3.

nancy either of the stomach or of the transverse colon. It should be emphasized that all cases of hematoma do not necessarily give a positive history of trauma.

Another extremely interesting condition is ossification of the scar of an abdominal

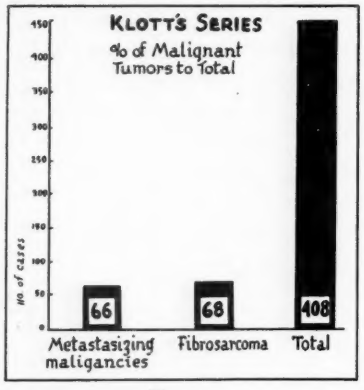

Fig. 4.

wound. The first description that could be found of this condition was by Askanazy[11]

Table II

	Pure Fibroma	Cellular Fibroma	Fibro-sarcoma	Sar-coma
Total Cases	92	23	54	44
Local recurrence after radical removal.....	1	1	5	13

in 1900, but it was not until 1909 that a detailed study was made by Lecene.[12] In 296 cases collected by Schulz,[13] 232 gave a history of severe blunt force. Ossification rarely follows in wounds made by sharp

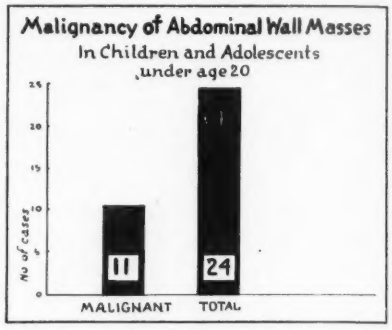

Fig. 5.

instruments. Kuttner[14] in 1910 could find only five cases of ossification of incisional abdominal wounds; in 1925, Bouton reported twenty-five more and added three personal cases. The largest personal, well described series is that of Chauvin and

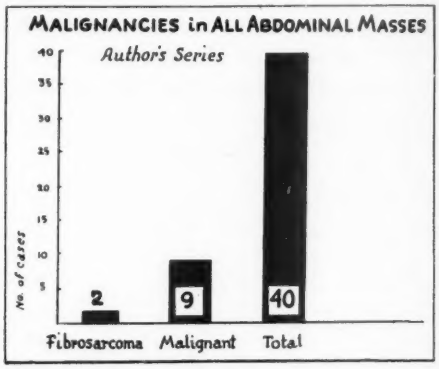

Fig. 6.

Rouslacroix.[16] In these, both direct and chondral bone formation could be demonstrated. The patients, ranging in age from 54 to 74, had cystotomy wounds preparatory to a second stage prostatectomy. At the time of the second operation, the original scars were removed. It is obvious that in this group of cases secondary irritation played an extremely important rôle in this metaplasia.

Calcification and even bone formation may take place in wounds following perfectly clean operations. The former is demonstrated by a case of Dean Lewis:[17]

A white male, age 27, following a gastroenterostomy for an ulcer of the duodenum

developed a painful wound three weeks postoperatively and had at the end of seven weeks a hard mass the length of the wound and a fingerbreadth wide. Roentgenograms showed a marked increase in density.

In Case IV of this series, previously reported in full by I. Cohn,[18] there was undoubtedly histologic evidence of bone formation in a lipoma. In addition calcification may take place in a hematoma. That occasionally a calcified mass may be malignant is demonstrated by a beautifully illustrated case of Pecco's:[19]

A 29 year old white female had a left lower quadrant tumor in the abdominal wall without any symptoms other than an increase in the size of the growth. This was removed and the patient had a rapid recurrence which was removed while she was still in the hospital convalescing from the first operation. The histologic picture was one of new bone formation with numerous osteoblasts. The pathologic diagnosis was osteoblastoma.

Pecco cites a similar case described by Hanseman.

Neurofibromas have been reported in almost every anatomic location in the body and the abdominal wall is no exception. They need not be associated with the typical syndrome of von Recklinghausen's disease. In our series there were three cases (Cases I, III and V) which were characterized by the symptoms of loss of weight, gastrointestinal disturbances, and, in contradistinction to the other primary tumors, by persistent pain.

Along with the other connective tissue tumors must be considered the more common lipoma (Case XXIV) and the infrequent endothelioma and angioma.

Tumors of ectodermal origin occurring in the abdominal parietes are dermoids, moles, and epithelioma. The last occurred usually in the umbilicus and its proximity. One should, however, realize that in this region also occur metastases from intra-abdominal neoplasm, i.e., from the stomach, colon, and ovary (pseudomyxoma peritoni), and in addition, urachal and omphalomesenteric duct epithelial tumors.

Durante[9] described a case of an umbilical tumor in a female 56 years of age, which was present for over twelve years and then suddenly began to grow. When seen it was the size of a mandarin and had ulcerated on the surface. It was excised and showed histologically numerous epithelial pearls and definite signs of malignant changes. He considered this tumor as arising from epithelialized tracts of retracted obliterated vessels and not an urachal tumor.

In our series is a case (Case XXXVI) in which a cyst excised from the lateral abdominal wall could not be histologically differentiated from a sebaceous cyst, but which, however, contained a brownish-black secretion which strongly suggested that it was a dermoid.

Foreign bodies have a rôle in the production of abdominal wall masses. While in the continental literature since the time of Schloffer's[20] report in 1909, there have been sporadic case reports of tumors caused by silk ligatures, there does not seem to be any American or English publications, in spite of the growing use of silk and other non-absorbable sutures and ligature materials. As Marangos[21] has indicated, these tumors may appear from a month to twenty years after the implantation of the foreign body. He cites the following case:

An 18 year old white female had an appendectomy three years before admission to the Clinic. She complained of severe pain, vomited, and was not relieved by conservative treatment. The removal of the tumor promptly relieved the symptoms. Histologic examination of the mass showed it to be fibrous and in the center was a silk ligature.

Characteristically, this type of tumor consists of solid fibrous tissue with an area of round cell infiltration about a foreign body. It is encapsulated but difficult to separate from the surrounding tissue, sharp dissection being required for removal. Schloffer[20] called attention to the fact that the removal of the foreign material usually caused complete regression of the mass. In our series a case of this type (Case II) occurred. A portion of a mass which occurred in a two months old herniorrhaphy

scar ware moved and while the pathologic diagnosis was sarcoma, the remaining tumor disappeared within a month.

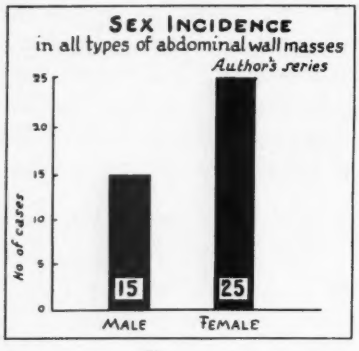

FIG. 7.

Recently Feinberg[52] described two cases of abdominal wall granuloma occurring in wounds in which were found talcum powder crystals (magnesium silicate). No doubt these cases should serve to remind the surgeon that a sterile water wash of his gloves before operating may save him and the patient from future trouble.

While there are countries in which irritation of the abdominal wall from hot charcoal pots produces epithelioma, in this country the source of irritation is *x*-ray and radium, which are applied commonly to the lower abdomen of the female. Polano[22] reports such a case as late as 1929:

A white female, age 36, had irradiation for bleeding myoma of the uterus three years before. She was seen in the Clinic with an ulcer of the abdominal wall which had involved the anterior bladder wall. A biopsy showed this to be a squamous carcinoma.

As should be emphasized, irradiation should be given only by those who have a thorough understanding of and a proper training in the physics and administration of *x*-radiation and radium.

Deep abdominal wall abscesses have occurred, some accompanied by severe symptoms and others by mild manifestations. Some follow injury which results in local necrosis, lowered resistance, and then secondary infection; others are blood-borne, such as the typhoid and pneumococcus types. Lavenant[23] reported a case of contusion hematoma which showed typical signs of inflammation fifteen months after the original injury, without surgical interference in the meantime. In our series is a case (XXVII) following injury, in which the abscess was partially drained and the remainder of the abscess subsequently ruptured intraperitoneally with a resulting fatality. Santoboni[24] reported a case of abdominal wall nonspecific granuloma. A similar case (XXXII) occurred in our series:

A 39 year old female with no history of previous injury had a mass below and to the left of umbilicus. Histologically the tumor was composed of fibrous tissue with focal areas of cellular infiltration consisting of round cells with a few polynuclears. There were no epithelioid or giant cells present which might suggest tuberculosis.

The chronic specific infections, the most important of which are syphilis (gummas) and actinomycosis, offer difficulties in making accurate diagnoses of abdominal wall lesions. In our series there were three gummas (Cases VII, XI, and XXI). One of these was diagnosed as sarcoma and excised. The others were treated conservatively and regressed. Actinomycosis usually is accompanied by secondary sinuses communicating with intraabdominal lesions. However, Saltzmann and Kessler[51] described the following case of actinomycosis, primary in the abdominal wall:

A female, age 18, had a mass the size of a grapefruit in the lower right quadrant which appeared to be fixed to the abdominal wall. There was a small sinus surrounded by induration in the left lower quadrant. Incision of the right lower quadrant mass showed that the sinuses did not penetrate the peritoneum.

Echinococcus cysts[8] have occasionally been reported.

In the present series the male-female ratio is 1 to 1.7 (Fig. 7) which is considerably less than that shown in Klot's series[4]; this comparison shows the fallacy of drawing conclusions from a small number of cases. The incidence of metastatic lesions in abdominal wounds is very small as com-

pared with a large number of abdominal sections done over a period of thirty years.

Practically every intra-abdominal viscus may be the origin for tumors which metastasize to abdominal scars. Wagner[3] reports a papillary cystadenoma of the ovary metastasizing to an abdominal scar and there are other reports of this happening from the same type of tumor (Devorak,[25] Danforth,[26] Tauber,[27] etc.). Gerlack[28] observed extention from a papilloma of the kidney pelvis; Jacobson[29] and Pratt[30] from the endometrium; Mayer[31] from peritoneal carcinomatosis following paracentesis; McDonough[32] from a granulosa cell tumor of the ovary following oöphorectomy, and in our present series implantation in the abdominal wall following surgery of gastric, colonic, and cholecystic carcinoma.

The following are the cases which we have personally seen:

Case 1. E. F., a colored female, entered Charity Hospital in March, 1937, complaining of pain and a "lump" under her ribs on the right side of the abdomen. The pain was colicky in nature and associated with a loss of appetite and vomiting. After a year of such attacks she felt the "lump" beneath the ribs which "worried" her. She had an acute attack in March, 1937 during which she came into the hospital.

Because of the previous attack, the fever, the extreme tenderness, and a mass in the right upper quadrant, the diagnosis of acute empyema of the gall-bladder was made. A laparotomy was performed through a high right rectus incision. There was found a mass of adhesions and omentum over a markedly distended gall-bladder. A trochar was introduced and a pint of pus was evacuated following which a scoop was introduced and over 200 stones removed. A pezzar catheter was inserted into the gall bladder and brought out lateral to the main incision. The patient did fairly well postoperatively and after two weeks an attempt was made to remove the tube but this was unsuccessful. Although every day for ten days further attempts were made, forcible removal of the tube under anesthesia finally had to be done.

The patient returned home and for a period of two months did quite well. She then noticed a steady pain at the site of the drainage wound which had just closed. She tolerated this for eight months, when she noticed a "lump" in the same area.

She reëntered the hospital January 20, 1938. A crust was found over the site of the drainage wound and surrounding it a mass, 4 cm. in diameter, apparently extending to the fascia. The skin showed increased pigmentation and was firmly attached to the tumor. The right rectus wound did not seem to be involved. The patient was obviously in considerable pain. Roentgenologically, the gall-bladder was nonfunctioning. The urine was negative chemically and microscopically. Blood examination showed R.B.C. 2.5, hemoglobin 75 per cent W.B.C. 8,000, with polynuclears 36 per cent, lymphocytes 60 per cent, monocytes 4 per cent. The urea clearance was 100 per cent, the icterus index 8, and hippuric acid liver function test 75 per cent of normal. The Wassermann was negative.

A biopsy showed only scar tissue. It was then decided to remove the mass and possibly do some more radical procedure. However, an incision encircling the tumor showed that it was infiltrating laterally and medially with the main mass about the old drainage tract. A frozen section showed adenocarcinoma, probably from the gall-bladder. No operative procedure other than the removal of the accessible portion of the mass was done. The tumor extended intra-abdominally and there were undoubtedly liver metastases. Roentgenograms of the pelvis, spine, and skull showed no bony metastases. The patient was given deep radiotherapy even though the prognosis was hopeless.

In a careful review of the literature of abdominal wall masses covering the period for Marion Sim's[33] first cholecystostomy in 1878 to the present, we were unable to find a case similar to this, in spite of the fact that cholecystostomy was the most common operation on the gall-bladder until 1920. Of course, it is admitted that carcinoma of the gall-bladder is an uncommon lesion, for, according to Deaver[34] and MacCarty,[35] it occurs but once in 200 operated gall-bladder cases. Deaver states that occlusion of the cystic ducts by malignancy causing stasis results in an

empyema which is commonly the first manifestation of the disease.

Case II. B. S., white female, age 54, entered Touro Infirmary, January 14, 1930, complaining of "vomiting blood" and coffee ground material. At the onset of the symptoms she had a desire to defecate. She had previously been treated for ulcer over a period of twenty years. Two months before entry to the hospital, the patient had noted a non-painful nodule to the left and above the umbilicus. This was removed and a report of "melanosarcoma" made. The patient left the hospital eleven days later much improved. Following discharge she did not have any more hemorrhages but continued to go downhill and develop masses in the abdomen which were apparently retroperitoneal. The main mass was in the umbilical region and extended into the left lumbar area. However, there were multiple tumors palpable throughout the abdomen and particularly in the iliac gland region. A roentgenogram of the chest was not made. Just before exitus, fluid developed in the abdomen probably from venous obstruction.

As in other locations a mole on the abdominal wall is not necessarily innocent as a wide variety of irritations may occur. However, melanosarcoma does not necessarily have to originate in a nevus because, in the above case and also in Case XXXVI, the lesion started as a subcutaneous nodule and progressed rapidly with fatal termination. Becker[36] reports a similar case in which the original nodule was on the abdomen and metastases occurred in the axilla.

Case III. F. T., colored male, age 50, entered Charity Hospital in January, 1938, complaining of two large tumors on his abdomen, loss of weight, and epigastric pain. He had been in the hospital two years before with a similar complaint except that there was but one tumor. On his first admission he was considered to have carcinoma of the stomach with metastases to the region of the umbilicus. He was then discharged and given sedatives for relief of the pain.

Physical examination at the time of his second admission showed an emaciated colored male with two masses on his abdominal wall; one, 1½ inches below the xyphoid, measuring 6 by 8 by 3.5 cm., was covered by skin and was moderately firm in consistency. There were small papillary projections from this mass. The second mass was below and to the left of the umbilicus similar in nature to the first and measured 14 by 12 by 5.5 cm., and on its summit was an ulcer 4 cm. in diameter. There were fewer papillary projections from this one. A biopsy was done as the diagnosis was uncertain. The pathologic report by Dr. Shattenberg was "neurofibroma." The patient refused further therapy and deserted from the hospital.

Case IV. E. L., colored female, age 55, was admitted to Charity hospital September 18, 1934, complaining of "hernia" in the right lower abdomen and high blood pressure. From birth, the patient had had a soft mass in the right lower abdomen which she claimed was reducible before puberty but not since then. It had remained constant in size since puberty.

Physical examination showed a mass in the right lower abdomen extending from the anterior superior spine to beyond the symphysis pubis. It measured 16 by 8 by 8 cms. The skin was smooth, the veins slightly prominent, and when the skin was stretched there was some dimpling. The mass was lobulated and in its lower half some hard, somewhat sharp projections could be felt. It transmitted light in most of its extent. It could not be reduced. There were no enlarged inguinal nodes. Examination by *x*-ray showed an irregular calcified mass, probably a cyst to the right of the midline and apparently in the pelvis. The mass was excised and found to be a partially ossified lipoma. A roentgenogram of the pelvis after convalescence showed the previously mentioned calcified mass still present. Bimanual examination identified this as a calcified ovary.

COMMENT

The diagnosis of abdominal wall masses is not difficult if they are kept in mind. Their differentiation from intra-abdominal tumors is of prime consideration. If they are fairly well limited, it is relatively easy to get the "feel" of the mass as being either intra-abdominal or intramural. By far the greatest number of these masses occur below the umbilicus and in the female are most frequently desmoids. However, hematomata have a tendency to blend with the

surrounding tissues and are therefore most confused with intra-abdominal lesions. Culbertson[10] showed that abdominal wall lesions were suspected and diagnosed only five times in forty-one cases, intra-abdominal conditions being diagnosed in all of the others. Fothergill[37] and Gellert[38] had similar experiences. Halban[39] suggests bimanual examination with the vaginal hand touching the lower pole of the tumor which, if intramural, recedes from the hand when the patient sits up and at the same time appears more prominent on the wall as the muscles contract. If the mass is in the abdomen the reverse is true. In the male, the same methods may be used using the rectal route. With the recent perfection of abdominal endoscopy there is no good reason why peritoneoscopy should not be used in differentiating parietal from visceral masses. We believe that an *x*-ray examination of the chest and skeleton for possible metastases should always be done before treatment is instituted.

It may well be said that the most practical method of diagnosis is biopsy followed by microscopic examination of the tissues.

The prognosis varies with the histology and location of the tumor, the completeness of operative removal and the presence or absence of metastases. We believe that the presence of malignancy in a scar does not necessarily indicate that the intra-abdominal lesion has progressed. It may be only a local recurrence, probably due to a break in the operative technique or the deliberate failure properly to protect the abdominal wall at the time of the original procedure. We are aware of the difference of the biologic response in each patient to the new growth and therefore there are times when only the continued follow-up of the patient will give the final answer.

The following thirty-six cases were abstracted from the available records of Charity Hospital for the years 1906 to 1939, and together with the cases reported in detail, form the basis for the authors' statistics.

I. NEUROFIBROMA: (1906) A colored male, age 33, was hospitalized in March, 1906, complaining of sore spot at the umbilicus associated with swelling which began early in 1905. A rapid increase occurred in size of the tumor during March, 1906, with marked loss of weight and intermittent darting pain about the tumor mass. The patient was emaciated. A large tumor was present at the umbilicus with small nodules on it. It was movable with the abdominal wall and not attached to intra-abdominal structures. Clinical diagnosis was fibrosarcoma. Treatment: excision. Pathologic diagnosis: neurofibroma. Result: recovered but no follow-up.

II. MYXOSARCOMA: (1911) A white male, age 52, had a herniorrhaphy two months before. Two weeks after leaving the hospital he noticed a lump under the scar, which was not painful but was tender. The patient was well nourished. A firm mass, the size of a large pecan was apparently fixed in the scar just above the right inguinal ligament. Clinical diagnosis: none. Pathologic diagnosis: myxosarcoma. Treatment: partial excision. Result: cured, no recurrence.

III. FIBROMA: (1911) A white male, age 16, had been struck in the lower abdomen three months before. He developed a mass below the umbilicus over a period of two weeks. No further increase in size occurred. Well nourished. There was a mass 2.5 inches in diameter, below and to the left of the umbilicus, apparently fixed in the wall, possibly rectus sheath. Clinical diagnosis: sarcoma. Treatment: excision. Pathologic diagnosis: fibroma with hemosiderin. Result: cured.

IV. FIBROSARCOMA: (1912) A white female, age 22, noticed a small lump six months before admission. It grew slowly and there were no other symptoms. There was a firm mass beneath the skin in the region of McBurney's point. The skin moved freely over it. Clinical diagnosis: ab-

dominal wall tumor. Treatment: excision. Pathologic diagnosis: fibrosarcoma. Result: no recurrence.

V. NEUROFIBROMA: (1912) A colored male, age 56, complained of a tumor in the right upper abdomen which had grown rapidly over a period of six weeks and was accompanied by moderate persistent pain. There was a mass the size of an orange beneath the skin and attached to the underlying muscles and fascia in the right upper quadrant. Clinical diagnosis: abdominal wall tumor. Treatment: excision. Pathologic diagnosis: neurofibroma. Result: unknown.

VI. FIBROMA: (1914) A colored female, age 45, had a tumor removed from the belly wall ten months before. Two months later she noted a "knot" in the scar. There was no pain, but there had been hemorrhage from the vagina for one month. The tumor was in the midline below the umbilicus and was attached to the scar. It was the size of an orange, non-tender, and the skin moved over it except at the scar. Clinical diagnosis: sarcoma. Treatment: excision. Pathologic diagnosis: fibroma (desmoid). Result: unknown.

VII. GUMMA: (1915) A white female, age 34, complained of pain in the epigastrium to the left of the midline, present for six months. There was occasional relief for periods of two to three days. For two months she had noticed a tumor. This thin female had a hard, non-tender, midline supra-umbilical mass, poorly delimited, which seemed to be in abdominal wall. Wassermann reaction was 4 plus. Clinical diagnosis: sarcoma. Treatment: excision with iodides and mercury following surgery. Pathologic diagnosis: gumma. Result: unknown.

VIII. FIBROMA: (1915) A colored female, age 36, had noted a pimple on the skin of the abdomen one year before admission. This increased in size until three weeks before admission, when it burst. White creamy material was discharged and a decrease in size followed. The patient had lost 15 pounds. She was undernourished, with a mass 3 inches in diameter, definitely limited, the bulk of which seemed to be in the abdominal wall. The skin was adherent only at the ulcerated area. Wassermann negative. Clinical diagnosis: gumma. Treatment: iodides and mercury without result. Excision with removal of half of rectus muscle. Pathologic diagnosis: fibroma (desmoid) with areas of infections and necrosis. Result: cured, no recurrence.

IX. FIBROMA: (1916) A colored female, age 19, noted a lump in the "stomach" ten months before admission. There was gradual increase in size, but no pain until four days before entry. The abdomen was lax, with a tumor in the left side, the size of a small pumpkin. It was apparently attached to the left rectus muscle. Wassermann positive. Clinical diagnosis: gumma. Treatment: iodides and mercury for two months without result, followed by biopsy. Pathologic diagnosis: fibroma (desmoid). Result: unknown.

X. FIBROSARCOMA: (1916) A colored female, age 35, noticed a knot in the right side of the abdomen ten months before admission, which steadily increased in size. A biopsy was done elsewhere, but the patient did not come into the hospital until five months after. A mass 3 inches in diameter was seen in the abdominal wall. A bleeding ulcer was on its summit. Wassermann negative. Clinical diagnosis: benign abdominal wall tumor. Treatment: excision. Pathologic diagnosis: fibrosarcoma. Result: three recurrences in thirty months.

XI. GUMMA: (1920) A colored male, age 41, complained of a painless tumor in mid-abdomen, present for five months. A similar one appeared two months after the other, but gradually disappeared over a period of six weeks. The patient was thin with a raised, flat, non-tender tumor 2.5 inches in diameter, with indefinite

border in the abdominal wall above and to the left of the umbilicus. There was no bulge on coughing and the rectus sheath seemed involved. Wassermann positive. Clinical diagnosis: gumma. Treatment: iodides and mercury rubs. Result: tumor disappeared in seven weeks.

XII. FIBROMA: A colored female, age 22, had noted a tumor, the size of a marble in the right lower abdomen one year before admission. It was not painful at first but seven months later it became so. A miscarriage occurred six weeks before entry to hospital. The patient was well nourished and the abdominal wall lax. In the right lower quadrant, just above the pubic spine was a hard, irregular movable mass, size of baseball. It was palpable through the vagina, but it was difficult to determine if it was of adnexal origin. Wassermann negative. Clinical diagnosis: intraligamentary myoma. Treatment: excision of mass and portions of external oblique, internal oblique and transversalis muscles. Peritoneal cavity entered. Pathologic diagnosis: fibroma (desmoid). Result: cured, no recurrence.

XIII. FIBROMA: (1922) A colored female, age 40, complained of a lump in the abdomen, which began three months after a gall-bladder operation (August, 1919). Some drainage came from the wound at intervals since then. The mass slowly increased in size. The patient was obese. A draining sinus was seen in the old scar. To the right of the sinus and umbilicus was a firm mass, the size of an orange, which was freely movable laterally but not caudad or cephalad. The overlying skin was warmer than the surrounding skin, and movable over the mass, which was tender on pressure. Wassermann not reported. Clinical diagnosis: abscess. Treatment: incision followed by excision. Pathologic diagnosis: fibroma (desmoid). Result: cured, no recurrence.

XIV. FIBROMA: (1924) A colored female, age 20, four months before entry noticed a lump on her abdomen inside her hip bone. The tumor gradually increased in size until she was unable to put her clothes over it. A swelling just medial to the anterior superior spine of the iliac crest, the size of an orange, movable and very firm, was apparently attached to ilium. Wassermann not reported. Clinical diagnosis: sarcoma of ilium. Treatment: excision of mass along with portion of external oblique, internal oblique and transversalis muscles. Pathologic diagnosis: fibroma (desmoid). Result: recovered, but no follow-up.

XV. ROUND CELL SARCOMA: (1925) A colored male, age 27, had a gunshot wound of the abdomen ten months before entry, followed by sinus formation which healed and recurred. Two months before entry he noted a small lump about sinus. Patient had lost 35 pounds and showed marked loss of weight. Numerous acorn-sized masses were beneath the skin of the abdomen. Four scars were present, one draining. No enlarged lymph nodes were noted. Wassermann negative. Clinical diagnosis: abdominal sinus. Multiple tumors. Treatment: biopsy. Pathologic diagnosis: round cell sarcoma. Result: died, no autopsy.

XVI. METASTASIS FROM EMBRYOMA OF TESTIS: (1925) A colored male, age 65, four months before entry noticed a growth on the abdomen just below the navel. One month later he noticed a lump in the groin, followed by many smaller ones on the abdomen. He was elderly and thin. Below the umbilicus were many rounded masses varying from peanut to golf ball size. The overlying skin was purplish pink and bled easily when irritated. Genitourinary examinations were negative. The extremities showed pitting edema. Clinical examination: multiple abdominal wall tumors. Treatment: none. Pathologic diagnosis (autopsy): embryoma of testis with metastases to

inguinal nodes, abdominal wall and diaphragm.

XVII. FIBROMA: (1925) A white female, age 27, noticed a lump next to the navel, six months before entry, which increased in size rapidly and was painful on exertion, such as coughing, sneezing, and defecation. Below and to the right of the umbilicus was a firm, tender tumor mass size of hen's egg which was unreducible and did not transmit impulse on coughing. Clinical diagnosis: lipoma. Treatment: excision with portion of rectus sheath. Pathologic diagnosis: fibroma (desmoid). Result: cured, no recurrence.

XVIII. FIBROMA: (1925) A colored female, age 27, noticed a "knot" in the right side of her abdomen one year before entry. It grew from marble size to fist size in three months and was excised elsewhere. Six months after surgery the "knot" appeared in the scar and grew very rapidly. On the abdomen, underlying a scar and extending from the costal margin to just above the symphysis was a multilobular freely movable mass, 8 by 4 by 5 inches, which varied in consistency, soft in some areas and hard in others. Clinical diagnosis sarcoma. Treatment: excision of mass and four-fifths of right rectus sheath and muscle. Pathologic diagnosis: fibroma (desmoid). Result: cured, no recurrence.

XIX. FIBROMA: (1929) A white male, age 43, noticed a lump on the abdomen four months before entry. The lump was painful at intervals. There was a marble-sized mass to the left of the umbilicus, palpable but not visible. No cough impulse was present and the skin was freely movable over the mass. Wassermann negative. Clinical diagnosis: fibroma. Treatment: excision along with portion of rectus sheath and muscle. Pathologic diagnosis: fibroma (desmoid). Result: no follow-up.

XX. GUMMA: (1930) A colored female, age 35, noticed a hard lump in the right side of the abdomen above the navel two weeks before admission. The tumor was not painful. The patient was thin, not acutely ill. There was a rounded mass in the upper right abdomen beneath the skin. The skin was tender and slightly warmer than the surrounding integument. Generalized lymphadenopathy, temperature 98.6°F., Wassermann positive. Clinical diagnosis: gumma. Treatment: iodides and mercury. Results: mass disappeared by thirty-seventh day.

XXI. FIBROMA: (1930) A white female, age 38, was operated on two years before entry for a tumor on the abdomen. Four months after surgery some pain was felt in the scar and then the tumor was noted. There was a mass in the right upper quadrant, 2 inches in diameter and beneath old scar. It lay just below the rib and seemed attached to it. Wassermann negative. Clinical diagnosis: chondroma. Treatment: excision. Pathologic diagnosis: fibroma (desmoid). Result: no recurrence.

XXII. FIBROMA: (1931) A white female, age 23, had intermittent pain below the umbilicus for six months postpartum. Two years later she noticed a tumor just above the pubic bone, in which pain occurred on exertion and coughing. In the lower abdomen just above symphysis pubis was a smooth globular mass 6 inches in diameter, firm and attached to pubis. The overlying skin was not attached. The mass was moderately tender Wassermann negative. Clinical diagnosis: fibrosarcoma. Treatment: excision of mass which was found to involve rectus sheath, conjoined tendon, fascia of external oblique, and internal oblique and transversalis muscles. Pathologic diagnosis: fibroma (desmoid). Result: no recurrence and no hernia.

XXIII. FIBROLIPOMA: (1932) A colored female, age 50, noticed a lump the size of a marble in the left lower abdomen two months before entry. The mass grew to the size of a grapefruit in two months. One week before entry

the tumor became painful. The patient was obese. There was a mass, in the left lower quadrant just above and medial to Poupart's ligament. The tumor was fixed, non-tender and the overlying skin shiny. Wassermann positive. Clinical diagnosis: sarcoma? gumma? Treatment: excision of encapsulated mass easily peeled from external oblique fascia. Pathologic diagnosis: fibrolipoma. Result: cured.

XXIV. HEMATOMA: (1933) A colored female, age 49, complained of pain in the abdominal tumor which she noticed eight days before entry. The mass appeared about six hours after she had lifted a heavy clothes tub. There was a mass in the right lumbar region 2 inches in diameter. The overlying skin was slightly discolored and the mass acutely tender. Wassermann negative. Clinical diagnosis: hematoma. Treatment: aspiration of 5 c.c. of old blood with slight reduction in size of tumor and relief of pain. Result: mass disappeared in forty days.

XXV. FIBROMA: (1934) A colored female, age 21, complained of pain in the lower right side of two years' duration, and for two months before entry she was unable to lie on that side. The patient had not noticed any tumor. There was a fairly firm, orange-sized mass in the right lower quadrant, which felt cystic, was movable, and vaginal examination suggested that it was attached to adnexa. Wassermann negative. Clinical diagnosis: ovarian cyst. Treatment: laparotomy showed mass anterior to peritoneum and involving lateral border of rectus sheath, conjoined tendon, external oblique fascia, internal oblique and transversalis muscles. Excision of mass. Pathologic diagnosis: fibroma (desmoid). Result: recovered, but no follow-up.

XXVI. INFECTED HEMATOMA: (1934) A colored female, age 41, was struck in the upper abdomen by a large stone three weeks previous to admission. This injury was followed by a moderate sticking pain and a week later the patient noticed an egg-sized mass in the upper right abdomen at the site of injury. Fever was present for a week. The patient was well nourished and moderately ill. A circumscribed, tender, slightly movable mass extended from below the ribs to just below the umbilicus on the right. The skin was movable over the mass and there was no increased heat. Temperature was 103°F. Wassermann negative. Clinical diagnosis: intraperitoneal hematoma, secondary infection with localization? Liver abscess? Treatment: incision and drainage of extraperitoneal abscess. Result: died following rupture of abscess pocket into peritoneal cavity.

XXVII. METASTATIC CARCINOMA: A colored male, age 52, had partial gastrectomy for carcinoma of stomach ten months before entry. Two weeks before admission began to vomit and have pain in the scar. The patient was emaciated. There was an indefinite mass in the abdomen and multiple nodules in and about the scar. Wassermann negative. Clinical diagnosis: metastatic carcinoma from stomach. Treatment: biopsy. Pathologic diagnosis: adenocarcinoma. Result: died.

XXVIII. ACUTE AND CHRONIC PHLEGMON: (1935) A white male, age 45, had a sudden sharp pain in the lower abdomen three weeks before entry. The pain gradually disappeared over period of three days. The patient then noticed a hard tumor in the right lower part of the abdomen. There was a hard, walnut-sized, slightly tender tumor with boundaries fading out into the surrounding tissue. It was apparently fixed in the muscles. Clinical diagnosis: abdominal wall tumor. Treatment: a tumor involving the external oblique, internal oblique transversalis muscles and transversalis fascia was excised. The peritoneal cavity was opened and the omentum found adherent to peritoneum at tumor site. Patho-

logic diagnosis: phlegmonous infiltration with large number of eosinophils and multiple areas of necrosis. Result: unknown.

XXIX. FIBROMA: A colored female, age 24, fell during pregnancy three years before entry. Shortly after the injury the patient noticed a tumor in the left side which did not bother her until three weeks before admission when pain occurred with coughing or laughing. There was an orange-sized, firm mass in the left upper quadrant although movable seemed attached to the wall rather than to intra-abdominal structures. Wassermann positive. Clinical diagnosis: gumma? rectus sheath tumor? Treatment: excision of mass along with part of rectus muscle and sheath. Pathologic diagnosis: fibroma (desmoid). Result: no recurrence or hernia.

XXX. FIBROMA: (1936) A colored female, age 27, noticed an egg-sized lump sixteen months before entry. The tumor gradually increased in size. Last menstrual period two months before admission. There was a mass 15 cm. in diameter extending from the umbilicus to just above symphysis pubis and a little to the left. The mass was smooth, firm and the skin moved easily over it. Wassermann negative, temperature 99°F. Clinical diagnosis: umbilical tumor, pregnancy. Treatment: excision of mass with portion of both rectus muscles and sheaths. Pathologic diagnosis: fibroma (desmoid). Result: no recurrence, large hernia.

XXXI. SCHLOFFER TUMOR: (1936) A white female, age 39, had pelvic operation four months before entry. Two weeks after surgery a lump was noticed in upper end of scar. One week before admission became painful and a small abscess drained leaving a hard lump beneath scar. There was a small granulating area in the upper end of the laparotomy scar with a golf ball-sized hard mass beneath, apparently extra-peritoneal. Clinical diagnosis: ulcerating malignancy. Treatment: excision of tumor by sharp dissection as no line of cleavage was present. Pathologic diagnosis: chronic granulation tissue with marked fibroblastic proliferation (Schloffer's tumor). Result: cured.

XXXII. METASTATIC CARCINOMA: (1936) A white male, age 52, had carcinoma of the descending colon removed in December, 1934. In January, 1936 a nodule, which had been present two months, was removed from the scar. The patient returned in May, 1936 complaining of pain and tumor in the scar. He was fairly well nourished. There was a hard mass 1.5 inches in diameter in the scar and firmly attached to the skin and underlying scar tissues. Wassermann negative. Clinical diagnosis: metastatic carcinoma from colon. Treatment: wide excision. Pathologic diagnosis: adenocarcinoma. Result: no recurrence for two years, no follow-up since.

XXXIII. DERMOID: A colored male, age 22, noticed at age 10 a small painless lump in the left side of the abdomen which had grown slowly and at intervals. There was a soft, goose egg-sized, freely movable mass above the left anterior superior iliac spine. Wassermann negative. Clinical diagnosis: lipoma. Treatment: excision of mass superficial to external oblique muscle. Pathologic diagnosis: dermoid contained thick brownish black fluid. Result: cured.

XXXIV. SPINDLE CELL SARCOMA: (1937) A colored male, age 17, noticed a painless lump in the right lower abdomen three months before admission. The mass increased in size rapidly. There was a large, nodular, slightly tender mass in the right lower quadrant extending to the pubic region and displacing the penis to the left. Wassermann negative. Clinical diagnosis: sarcoma. Treatment: excision of tumor. Pathologic diagnosis: spindle cell sarcoma. Result: pulmonary metastases and death in four months.

XXXV. SPINDLE CELL SARCOMA: (1937) A white male, age 52, had tumor removed from abdomen 30 months before admission. Eighteen months before entry he noticed a growth in the scar, which had grown slowly. There was a firm, non-tender, baseball-sized tumor in the old scar, which was firmly attached to the skin and underlying structures. Wassermann negative. Clinical diagnosis: abdominal wall tumor. Treatment: excision, removed scar, muscle and fascia down to peritoneum. Pathologic diagnosis: highly malignant spindle cell sarcoma. Result: no recurrence in a year, no evidence of metastases elsewhere.

XXXVI. FIBROMA: (1937) A colored female, age 26, noted a small mass below and to the right of the navel four months before admission. It was not painful and grew slowly. The last menstruation had occurred five months before. There was a rounded, firm, delimited, non-tender mass, the size of a large lemon, to the right and just below umbilicus. The overlying skin was normal and moved freely over the mass which was apparently superficial. No cough impulse present. Wassermann negative. Clinical diagnosis: fibroma, pregnancy. Treatment: excision of tumor with portions of rectus sheath. Pathologic diagnosis: fibroma (desmoid). Result: no recurrence or hernia at time of delivery four months after surgery.

SUMMARY

1. An orderly classification of abdominal wall masses is proposed.

2. The incidence of abdominal wall lesions as regards age and sex, relative malignancy and relation to previous history of the patient is given.

3. The frequency of desmoids in the female and high ratio of malignant to non-malignant masses in children and adolescence are emphasized.

4. Schloffer's foreign body (silk) tumor is either not being recognized or else not reported in the English speaking countries.

5. Abdominal wall hematomas should be strongly considered in the differential diagnosis of abdominal masses.

6. Forty-one cases of abdominal wall masses are reported from Charity Hospital and Touro Infirmary, New Orleans. Of these an adenocarcinoma of the gall-bladder metastasizing by direct extention to a cholecystostomy wound is reported for the first time.

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THE PREOPERATIVE AND POSTOPERATIVE CARE OF PATIENTS WITH GASTRIC CANCER*

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LORD Moynihan has said: "Surgery has been made safer for the patient; we must now make the patient safe for surgery." Twenty-five years ago George Grey Turner made the statement that those who contemplated operation for gastric cancer had "no thought but to kill two at a blow"—the patient and their own reputations. However, the present success attending the surgical treatment of gastric cancer is due not only to improvement in operative technique but also to a better knowledge of the preoperative and postoperative care of the patient.

PREOPERATIVE CARE

There are several consequences of gastric cancer one or more of which are nearly always present and must be considered in the preoperative preparation. These complicating conditions are: dehydration, malnutrition, anemia, gastric dilatation and retention due to pyloric obstruction.

Dehydration and Malnutrition. Dehydration and malnutrition are usually present in candidates for gastric surgery due to vomiting or abstinence from food and fluids for fear of pain or discomfort. Fluids given by mouth are preferable if they can be retained. Supplementary administration of fluids by parenteral routes is described on page 442.

In establishing a high glycogen reserve, ingested glucose has been shown to give a higher and longer sustained blood sugar elevation than glucose administered by the intravenous route. Sugar may be given as honey, lactose in orange juice, or in other ways up to the night before operation. Seale Harris employs lemonade containing 1 ounce of strained lemon juice to 5 ounces of 10 per cent glucose solution; or 2 ounces of strained orange juice to 4 ounces of glucose solution. These preparations may be given in 6 ounce feedings every hour during the day and every two or three hours at night when the patient is awake, up to within six hours of the operation. It can be used in the presence of cancer causing moderate obstruction.

No protein food should be given for twenty-four hours before operation, because water passes slowly out of the stomach during gastric digestion. Food containing protein would therefore favor or increase gastric retention. Fats are retained in the stomach even longer than protein and must be avoided in patients with gastric retention. Fats in excess may add to the acidosis associated with the operation.

During the preoperative administration of fluids, consideration should be given to the large percentage of patients with cancer of the stomach who have achlorhydria or low gastric acidity. Horsley keeps ½ of 1 per cent solution of hydrochloric acid sweetened to taste in a pitcher by the patient's bed for two days before operation and encourages its ingestion at frequent intervals. The antiseptic value of the hydrochloric acid is an additional advantage. Thirty to 60 minims of dilute hydrochloric acid may also be given in water three times daily, with pepsin gr. 2 and pancreatin gr. 2 to aid digestion.

Anemia. Gross hemorrhage from gastric cancer is not common, but long continued imperceptible small hemorrhages are the rule. Severe anemia is usually associated

* From the Memorial Hospital for Cancer and Allied Diseases. Aided by a grant from Mr. Lucius N. Littauer.

with gastric cancer, particularly the polypoid tumors situated along the greater curvature and in the fundus. This anemia has been confused on occasions with primary or pernicious anemia when only the changes in the cells of the circulating blood were considered (Doan). Because of the similarity of the blood picture to pernicious anemia and the known relation between the mucosal functions of the stomach and hematopoiesis, it is logical to assume that changes in this mucosal function may play a part in the causation of the anemia of gastric cancer.

Castle believes that the nutritional defect in patients with pernicious anemia is caused by failure of a reaction which occurs in the individual between food (the extrinsic factor) and a substance in the normal gastric secretion (the intrinsic factor). The administration of either factor separately has no effect (i.e., beef muscle—normal human gastric juice) but when they are given together (i.e., contact before or after administration to the patient) an improvement is seen within ten days and it is progressive. The activity of desiccated hog stomach mucosa is due to the presence of both intrinsic and extrinsic factors and positive effects are obtained from 30 Gm. daily. Castle and Ham represent the factors in a schematic formula: $\frac{F \times G}{I} = L.E.$ F is the food (extrinsic) factor; G is the gastric (intrinsic) factor; I represents intestinal impermeability and *L.E.* liver extract. Probably in none of the macrocytic anemias (as pernicious anemia, sprue, *gastric cancer*, dibothriocephalus latus infestation) is any factor on the left of the equation completely normal.

This knowledge is most helpful in the postoperative treatment of the anemia that may follow total or subtotal gastrectomy. The administration of such hematopoietic agents as desiccated gastric mucosa and liver extract is usually reserved for the postoperative state. The first step in the treatment of the anemia of gastric cancer is to remove the source of bleeding by gastrectomy and it is unwise to delay operation while attempting to improve the blood by medical means.

If the hemoglobin is below 40 per cent, blood transfusions are employed preoperatively and if response can be obtained without too much delay, an increase to 60 per cent is desirable. Even if there is little response the blood is of value and donors should be ready for use immediately after the operation.

Relief of Dilatation Due to Pyloric Obstruction. The oral administration of fluids and food may be impossible due to retention with dilatation of the stomach by partial or complete pyloric obstruction. This obstruction usually develops slowly in cancers of the distal third of the stomach and if accompanied by long continued vomiting is associated with disturbances in the acid-base balance or electrolytes of the blood. Gastric tetany following pyloric obstruction occurs when the cause of the obstruction is inflammatory as in infants, or adults with fibrosing ulcers and hyperchlorhydria, but is not a problem in the case of gastric cancer. Nevertheless, any pyloric obstruction, neoplastic or otherwise, which causes persistent vomiting will increase the carbon dioxide combining power of the blood and furnish an indication for the parenteral administration of chlorides.

A part or all the fluids must then be given by hypodermoclysis or intravenous infusions, preferably the latter method. The chemical status of the blood should be checked every forty-eight hours and normal saline or Ringer's solution given when necessary to maintain the level of blood chlorides.

The mucosa of the non-cancerous segment of the stomach is usually infected, edematous and congested; the gastric wall is atonic. These tissues are difficult to suture and, moreover, constitute a source of danger from infection of the suture line and possible perforation. Repeated gastric lavage and rest of the stomach with improvement of the general condition of

the patient by intravenous fluids will lessen the edema and congestion of the mucosa.

one or two days before operation and the stomach lavaged with hydrochloric acid solution especially if the free acidity is low

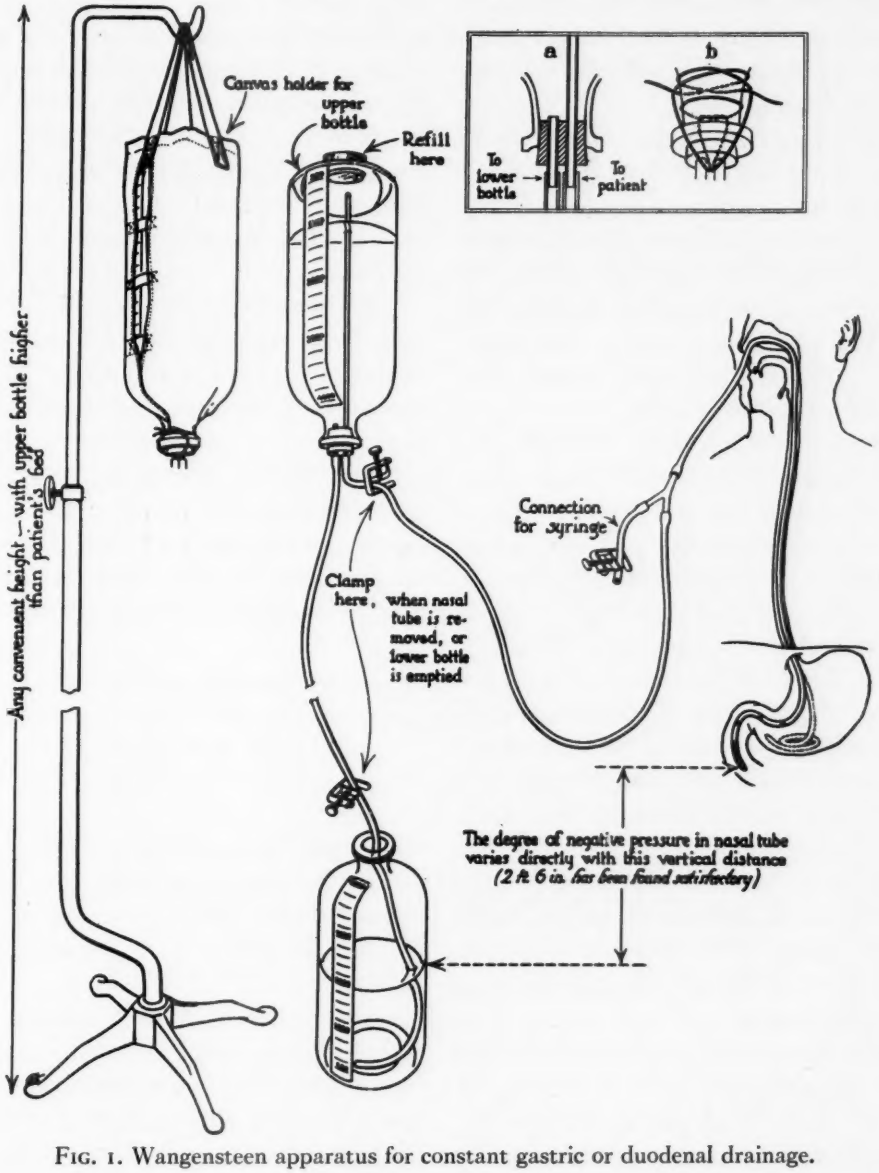
Canvas holder for upper bottle
Refill here
a
b
To lower bottle
To patient
Any convenient height — with upper bottle higher than patient's bed
Connection for syringe
Clamp here, when nasal tube is removed, or lower bottle is emptied
The degree of negative pressure in nasal tube varies directly with this vertical distance
(2 ft. 6 in. has been found satisfactory)

Fig. 1. Wangensteen apparatus for constant gastric or duodenal drainage.

Constant suction for decompression through a nasal catheter by the method of Wangensteen or related methods, accompanied by drinking 4 to 6 quarts of fluid per day, may be done when dilatation of the stomach is marked. (Fig. 1.) Hypochloremia must be especially guarded against if this treatment is continued over several days. In patients with retention who have had alkaline therapy, this continuous auto-lavage should be discontinued in the gastric contents. If the gastric acidity is low or absent, dilute hydrochloric acid, four teaspoonfuls (16 c.c.) to a quart (1,000 c.c.) should be used in the gastric lavage.

Finney has advocated the "sterile" preparation of the stomach for operation by several days of sterile feeding and systematic lavage. All gastric cancers are more or less infected, especially when ulcerated and associated with achlorhydria;

it is practically impossible to sterilize such a stomach, particularly when pyloric obstruction is present. A valuable adjunct in this effort is the use of antiseptic throat gargles, nasal sprays and the removal of infected teeth with the institution of proper dental hygiene.

Preoperative Rest in Bed. Debilitated patients are kept in bed for one or two days prior to operation in order to help build up their resistance and facilitate the administration of fluids. The average patient, however, is not put to bed previous to the operative day because activity improves his morale, pulmonary ventilation and muscular and circulatory tone.

Preparation of the Diabetic Patient for Gastric Resection. Because of the usual malnourished state of diabetic patients with gastric cancer it is desirable to use a high caloric diet with adequate insulin to lower the blood sugar in a few days to a week. The usual diet is 150 Gm. of carbohydrate, 100 Gm. of fat and 75 Gm. of protein. The blood sugar is never lowered rapidly in patients with arteriosclerosis. The ideal preoperative blood sugar is 150 to 200 mg. per 100 c.c. The urine may contain a few tenths of 1 per cent of glucose but should contain no acetone bodies. In the presence of a high degree of obstruction with gastric retention other methods of giving food may be necessary and the diet will be more limited.

Fluids and extra glucose are administered the day before operation and on the day of operation no fluid is given by mouth for six hours before the patient is taken to the operating room. If acidosis and hyperglycemia are not controlled and insulin is necessary, intravenous glucose with insulin is administered.

At the Beekman Street Hospital, Terry has formulated a scheme for determining the amount of insulin needed by the color of the reduction in the urine: he gives 15 units if there is red reduction, 10 units if yellow reduction, and 5 units if green. This insulin is accompanied by orange juice or ginger ale by mouth. Immediately after the operation, Terry gives 20 units of insulin with 1,000 c.c. of 5 per cent glucose. One hour later he gives 5 to 10 units of insulin and discards the catheterized urine obtained at that time. Two hours later the urine is examined and insulin given according to his color formula stated above. Six hours later he gives intravenous 5 per cent glucose with insulin coverage. One hundred Gm. of carbohydrate are given each twenty-four hours postoperatively by some route.

Careful observation for any evidence of metabolic abnormality is imperative as it is better to err on the side of too little control rather than too much, as slight glycosuria is not so dangerous as insulin coma. The surgeon should be aware of the frequency of cardiac complications in diabetic patients, particularly during the postoperative state; such a complication may be easily confused with insulin reaction.

GENERAL CARE OF PATIENTS AFTER OPERATIONS FOR GASTRIC CANCER

The postoperative course depends largely on the nature of the operation, the skill and ease of its execution and the degree of care in the preoperative preparation of the patient.

Adhesive tape is never placed too tightly around the upper abdomen especially over the costal margin. Sufficient carbon dioxide (10 per cent) and oxygen mixture is given by inhalation for fifteen minutes hourly for the first eight to twelve hours, to cause hyperpnea. This ventilation of the lungs is continued by encouraging the patient to take twenty deep breaths four times daily or to continue the carbon dioxide and oxygen mixture three times daily for an additional three days.

Codeine ½ gr. is allowed every four hours for two or three doses, then every six hours for another four doses. Although morphine is allowed for young and for vigorous middle-aged patients, it is rigor-

ously withheld from most subjects over 50 years of age, at least during the first forty-eight hours. Such patients seldom die of shock or fatigue, whereas heavy morphinization is only too often followed by pneumonia. In the experience of the authors, it has seemed best to permit a certain degree of restlessness of the patient, providing suffering is not too intense.

Slight Trendelenburg position is desirable until the patient reacts from the anesthetic. This may be continued if there is a poor venous return from the extremities or if bronchiectasis is present. The position otherwise is changed in the afternoon following the operation to a quarter sitting position.

A warm enema (40°C.) may be given after twenty-four hours. When the patient wishes to cough, it is well for the nurse to support the rectus muscles. External heat from a hot water bottle or electric pad may relieve rectus spasm.

The recent routine postoperative use of drugs to stimulate intestinal musculature seems to be valuable in the prevention of gas pains, postoperative distention and paralytic ileus. In the selection of drugs, the discoveries of Puestow should be followed. He was able to study the influence of these agents on the visible peristaltic activity of the large and small intestine because of the herniation of the cecum and terminal ileum in a patient who had the ileocecal segment isolated from the remainder of the intestinal tract. In brief, morphine, eserine and prostigmin stimulated increased peristalsis in the small intestine while at the same time peristalsis of the large bowel was paralyzed. On the other hand, pituitrin and pitressin stimulated increased peristalsis in the large intestine while at the same time peristalsis of the small intestine was paralyzed. No drug was found to stimulate both small and large intestine. Therefore in the selection of drugs, the surgeon should choose the proper one to increase the tonus of either the small or large intestine depending on where the gas accumulates. When morphine is used (in all but elderly patients) it is a most efficient stimulator of small intestinal motor activity, but should be followed first by enemas and later if necessary by pitressin to overcome the stasis in the large bowel. Potler and Mueller advocate the routine use of 1 c.c. (20 units) of pitressin to be given intramuscularly at the close of the operation and then repeated every four hours for six to ten doses. Where any peritonitis exists, the interval is two hours instead of four. If mechanical ileus develops it requires mechanical therapy, such as the use of the Abbott-Levine tube, ileostomy or operation to relieve the cause of the obstruction.

Diet. There are many postoperative diets in use throughout the United States today, and the majority are serviceable. The authors prefer, however, those postoperative diets in which small quantities of liquid food are given to the patient at frequent intervals immediately after the operation. There is no harm in early feeding, providing the surgeon is alert to the possibility of gastric dilatation. On the morning of the first three postoperative days a Levine tube is routinely inserted into the stomach, generally over a period of from thirty to sixty minutes, in order to remove any residual liquid. The following diet is one which was used years ago by Charles Peck of the Roosevelt Hospital in New York City. It is the standard diet employed at the Memorial Hospital for patients who have had gastric resection or gastroenterostomy.

As soon after operation as the patient is quiet, a 6 ounce 5 per cent glucose solution containing 40 gr. of sodium bromide, is administered as a retention enema.

Beginning four hours later, 6 ounces of tap water are given by rectum every four hours. This procedure is continued uninterruptedly for two days, if the fluid is retained.

Four hours after the operation, unless the patient is nauseated, 2 drams of hot water are given by mouth every two hours. This amount may be increased gradually until

as much as 1 ounce is given in the evening of the operative day.

First Day. The day following operation, 1½ ounces of water and 1 ounce of chicken broth without salt or pepper, are allowed alternately every hour. At night, water and other fluids are given only when the patient is awake.

Second Day. Add 1½ ounces of Martin's milk* every three hours and 1½ ounces of tea every four hours to the previously mentioned diet.

Third Day. Allow water in small quantities as required. Give fluid food 3 ounces every hour. Add 2 ounces of strained gruel three times during the day.

Fourth Day. Make the fluid food in quantities of 4 ounces at a time.

Fifth Day. The fluid food is increased to 6 ounces every two hours. Junket and custard are added in small quantities three times during the day.

Sixth Day. One coddled egg is added at luncheon. Milk of magnesia ½ ounce is administered at 9 A.M. and 6 P.M. after meals.

Seventh Day. Toast, cereal and cream are added in small quantities.

Eighth, Ninth, Tenth and Eleventh Days. There is no increase of diet.

Twelfth Day. A modified light selected diet is given; no crusts and no fruit, either raw or cooked, are allowed.

This diet is continued until the patient is discharged. The milk of magnesia is continued from the sixth day until the day of discharge, unless complications arise. The patients are not enjoined to follow a special diet after discharge from the hospital, as is the case after operations for gastric ulcer.

Postoperative Administration of Fluids. The amount and type of fluids required after operation should be such as to permit the ready continuance of normal body functions. The average daily secretion of digestive juices in man is 7,300 to 8,800 c.c. According to Rowntree, this distribution is as follows: saliva—1500 c.c.; gastric juice—2,000 to 3,000 c.c.; bile—300 to 500 c.c.; pancreatic juice—500 to 800 c.c.; intestinal juice—3,000 c.c.

The average intake of fluids in a normal individual with an average diet is approximately: drinking water—300 c.c.; liquid food—580 c.c; water content of solid foods—720 c.c.; water of oxidation from foods—300 c.c. The water of oxidation from fat is roughly twice as much as from the same amount of carbohydrate or protein. The measurement of postoperative fluid intake is accurate since the foods are all liquid for three or four days.

The loss of body fluids after operation is of great importance. In a normal person, the loss of water from the lungs is constantly about 300 c.c. daily; the loss through the kidneys varies with the intake, averaging 800 to 3,000 c.c.; the loss with feces is small, about 180 c.c.; but the skin eliminates a variable quantity since one of its functions is the dissipation of heat, and this loss of fluid amounts to one-third or one-half of the total extrarenal loss. The last factor is one which is often overlooked after operation.

Coller and Maddock have measured the actual fluid loss during operation. This must include loss by vomitus and hemorrhage in addition to the normal avenues of water elimination. The amount lost by vomitus during operation is not important, but the loss through hemorrhage is often greater than the surgeon believes, sometimes measuring 1,200 c.c. The patients observed who had operations on the stomach (one gastroenterostomy for carcinoma and one resection for carcinoma) lost 111 and 274 Gm. of blood respectively. The fluid elimination through the lungs and skin was at times as high as nine times that of the basal state, amounting to 1½ to 2 liters a day. A comparison of urinary output with the fluid intake did not give a correct estimate of water balance, because the urinary output averaged less than 10 per cent of the total fluid lost. Diarrhea

* Martin's Milk is prepared as follows: Dissolve junket tablets in water and add to warm milk. Allow to cool and then strain. The whey is Martin's milk. Or it may be prepared by adding 1 dram of liquid rennet to 1 pint of warm milk.

is another usually ignored source of fluid loss.

On the basis of his experiments Coller used 6 per cent of the total body weight in calculating the water requirement of the tissues in dehydrated patients. This estimation along with the consideration of the amount of fluid for vaporization, for abnormal losses and for a reasonable urine output gave him a rather exact indication of the amount of fluids needed to restore the dehydrated patient to a normal water balance. He considers a satisfactory urine output to be about 1,500 c.c. a day for sick patients as normal kidneys need to excrete about 500 c.c. of urine a day for normal function.

Maddock and Coller in a more recent article give the following table as the water requirement for a dehydrated patient weighing 60 Kg.

	C.c.
1. Water of vaporization	2,000
2. Water for urine	1,500
3. Abnormal loss during twenty-four hours	
4. Water to restore depleted fluids (6 per cent of 60 Kg.)	3,600
Total for twenty-four hours	7,100

Fantus made a statistical postoperative study of 2,000 patients at the Cook County Hospital, observing the quantity of urine, chlorides and glucose excreted. He concluded that patients should not be operated upon if they do not pass at least 1,500 c.c. of urine containing at least ½ of 1 per cent of chlorides the twenty-four hours preceding operation. If surgical treatment is necessary without these requirements the postoperative care will be more difficult. An excessively low or high salt elimination during the postoperative state is attended by a high mortality rate. Fantus also advised that very sick patients should not be given large quantities of fluid "unless grossly dehydrated."

Dextrose solutions are useful both to replenish the glycogen supply of the liver and to furnish nourishment. The action varies somewhat with the concentration and rate of administration. Five per cent solution of dextrose in water is an isotonic solution that is used chiefly to combat dehydration. More concentrated solutions of dextrose (10 to 50 per cent) are hypertonic and are eliminated fairly rapidly, thereby acting as a diuretic. If more than 0.4 Gm. of dextrose per pound of body weight per hour is administered, the carbohydrate will not be fully metabolized and is spilled into the urine, carrying water with it.

Salt solution acts chiefly in the blood to dilute the blood colloids and momentarily lower the osmotic pressure of the circulating fluid. An isotonic solution (0.85 per cent) after infusion or absorption into the blood stream is rapidly lost into the tissues, thereby restoring the water balance. Therefore it is not of much value in restoring and maintaining the volume of the circulating blood. It can on the contrary produce edema leading to convulsions, without an effective increase in the blood volume. Hypertonic salt solution (usually 2 per cent) introduced into the blood produces a transient return of fluid from the tissues into the blood stream but the balance is rapidly restored to normal because of the diffusibility of salt. Salt is not metabolized and a high salt content in the plasma interferes with the excretion of fluid through the kidneys, causing retention with demonstrable edema.

Ringer's solution contains in 1 liter of distilled water, sodium chloride 7 Gm., calcium chloride 0.25 Gm., potassium chloride 0.30 Gm. It is a buffer solution which has been preferred for intravenous infusions and its use will be discussed in that connection.

Hartmann's solution has the same constituents as Ringer's solution with the addition of sodium bicarbonate and dextrose. This buffer solution serves to restore the water balance, restore chlorides, replenish sodium, potassium and calcium ions in the proper proportions as well as supplying the sodium bicarbonate. It is especially indicated for pyloric obstruction, intestinal obstruction, gastric and intestinal fistulae.

METHODS OF ADMINISTRATION OF FLUIDS

Oral Method. Although unquestionably the best method of giving fluids, the intake by mouth must be restricted during the period of gastric wound healing. Small quantities of water and clear nourishing liquids are given at frequent intervals immediately after the operation. (See diet—page 440.) The suture line at this time is less likely to become disrupted than it is on the third and fourth postoperative day.

Intravenous Infusion. The technique of continuous intravenous drip for postoperative administration of liquids was described by Matas in 1924. He cited its use during operation with the primary massive introduction of isotonic solution followed by a continued drip of 5 per cent dextrose in water averaging forty to sixty drops per minute. Horsley in 1927 advocated the use of this method for administering 10 per cent glucose in Ringer's solution pre- and postoperatively in amounts ranging from 1,000 to 1,500 c.c., giving it at the rate of 150 to 250 c.c. per hour. In 1931 Horsley modified the type of cannula used for continuous intravenous infusion and changed to 5 per cent glucose in Ringer's solution for the usual patient and to 5 per cent glucose in distilled water for patients with kidney disease and edema. A transfusion of citrated blood may be given through the same cannula, while continuous intravenous administration of fluids is in progress. The physician should be alert for the manifestation of "water sickness" such as puffiness of the lower eyelids, unusual lacrimation and vomiting of clear or bile-stained fluid.

If the hospital is not equipped with a special unit to prepare solutions for intravenous use, then commercial solutions should be used. The solutions should be prepared properly and accurately, using pure chemicals and storing them in an aseptic vacuum bottle which should be dated, and not used when more than a week old. The exact measurement of correct temperature of the fluid is not important, if the solution is given slowly enough, as for example, 4 to 6 c.c. a minute. There may be some danger of embolism and thrombosis following a long intravenous administration of fluids, but this complication has not occurred in the writers' experience.

Recent work by Coller and Maddock, showing the effect of different solutions given intravenously to sick surgical patients for a number of days, will be briefly cited.

1. A group of patients were given 5 per cent glucose in normal salt solution, and all gained weight and retained water. If this was discontinued for oral administrations, or changed to 5 per cent glucose in water, the retained water was lost in all cases.

2. Five per cent glucose in Ringer's solution was given, and six of the seven patients had fluid retention. This also was lost when discontinued or the solution changed.

3. Five per cent glucose in water, given to a third group of sick surgical patients, caused no retention of water. Some patients lost weight due to utilization of body tissues for energy. It was concluded that 5 per cent glucose in distilled water provides for a normal water exchange, and the only reason that gross water retention was not seen more frequently with the indiscriminate use of saline solution was that it is generally not given for more than two or three days.

Coller and Maddock then studied the reasons for giving parenteral fluid in 100 surgical cases. In 20 per cent there was vomiting, and salt was therefore needed. The amount needed was determined in one of two ways: the vomitus was measured in some cases and an equal amount of Ringer's solution given. They preferred Ringer's solution for patients needing sodium chloride. In other patients, the blood chlorides and carbon dioxide combining power were determined. If these values were low, Ringer's solution was given in quantities of 1½ to 2 liters a day. The Ringer's

solution was alternated liter for liter with 5 per cent glucose in water. The duration of this treatment was determined by blood chemical studies every forty-eight hours. The other 80 per cent of patients were given parenteral fluids because they were unable to take sufficient fluids by mouth. In these cases, it was considered that solutions containing sodium chloride were unnecessary and dangerous.

Hypodermoclysis. Hypodermoclysis as a method of fluid administration is still used, but not to so great an extent as formerly, because of the more common employment of intravenous infusion over a continuous period. When this method is employed, it should be preceded by novocaine infiltration of the skin at the site of the introduction of the needle. In addition, 10 to 20 c.c. of 1 per cent novocaine solution may be added to the body of the fluid, in order to maintain continuous analgesic effect. Woodyatt's method, advocated several years ago, of using multiple small needles causes very little discomfort, and is deserving of more common usage. The subcutaneous tissues of the thigh are preferred to the subpectoral region because there is less embarrassment to respiration.

Proctoclysis. The rectal method of administration of fluids and glucose has generally fallen into disrepute and disuse. McNealy and Williams, in 1924, experimented with dogs and showed that there was no appreciable absorption of 5 per cent aqueous solution of glucose from the colon, although there was some absorption from the ileum. Pressman found in humans a fall in peripheral blood sugar after giving glucose per rectum. The findings were confirmed by de Takats and Scott and Zweighaft. Perusse found in dogs that a 1 per cent glucose solution was the ideal fluid, given rectally, for restoring water balance. It would seem that the total amount of dextrose absorbed from the colon under the best conditions is too small for any considerable immediate therapeutic effect. The rectal administration of fluid is indeed a very inefficient substitute for the oral route. Tap water alone may be given either by the Murphy drip or by the introduction of 4 to 6 ounces at a time, every three or four hours, as tolerated by the patient. The rectum and colon become intolerant of even the fluid, after twenty-four to thirty-six hours. The purpose of proctoclysis therefore is solely for the absorption of water, and not as a nutrient enema.

HEALING OF THE WOUND

A surgical wound is termed by Bigelow a self-limited disease. The strength of sutured wounds in skin, muscle, fascia, and gastric mucosa has been studied by Howes and his co-workers. During the first four days there is very little healing in all tissues, but during the first two days the wound is stronger than on the third or fourth day because of the strength of the suture material. Early healing is only an agglutination of tissues. The tensile strength of the agglutinated wound is not greater than that of the finest catgut. The weakness of the wound on the third and fourth days is due to autolysis and pressure necrosis around the sutures and varies with the amount of this reaction. Therefore, the least amount of trauma and of suture material necessary to approximate the tissues is most desirable. After the fourth to sixth day proliferation of the fibroblasts and endothelium strengthens the wound at first rather rapidly and then more slowly to a maximum strength in ten to fourteen days. This maximum strength is reached slightly later in fascia than in skin and muscle. Infection is the principal factor that retards the healing process.

The mode of healing of gastrointestinal anastomoses in dogs has been carefully studied by Flint. Healing by first intention may be complete in five to fourteen days, but it is not the usual occurrence. More often there is considerable exudation, destruction of tissues, demarcation of necrotic tissues and organization of exudate with regeneration of the mucous membrane, requiring the full fourteen days for

complete wound healing. The mucosa of the stomach is flattened and grows up and around or through the exudate, covering it before it grows down to form glands. As the cells of the mucosa grow older some with acidophilic reaction appear, increase in size and form young parietal cells while the other cells become chief cells. The muscularis mucosa may regenerate from itself, or cells may grow up from the inner circular muscle layer to form it. If this does not occur, the glands will push down into the submucosa. The muscular layers regenerate from the torn ends chiefly from the outer oblique layer, but considerable of the union between the muscles is accomplished by fibroblasts rather than myoblasts.

POSTOPERATIVE PULMONARY COMPLICATIONS

The pulmonary complications of gastric surgery occur more frequently in males than in females. Keen's statistics showed 9.1 per cent such complications in males as compared with 4.5 per cent in females. Eliason and McLaughlin found that 70 per cent of the patients in their series in whom these complications occurred were males.

It is generally believed that the type of anesthesia does not influence the incidence of pulmonary complications to any great degree; some reports indicate practically as high an incidence after spinal and local anesthesia as after the administration of general anesthesia. Rovenstine has found that the most important predisposing factor has to do with the plane of anesthesia. The deepest plane of anesthesia continued for an appreciable length of time doubles the incidence that is found in patients when analgesia as the first plane of anesthesia only is necessary. The duration of the anesthesia is also important, according to Rovenstine; when the time is more than ninety minutes the incidence becomes higher than the average incidence, and increases rapidly with every added half-hour. The authors' experience is contrary to general opinion, in that the frequency of pulmonary complications has been less than 6 per cent with the routine adoption of spinal anesthesia for gastric resection, or palliative operations for gastric cancer.

There is also a definite seasonal variation in the frequency of postoperative pulmonary diseases as there is in the incidence of pneumonia in the general population, the greatest incidence, as a rule, being in February, March and November. The occurrence of intercurrent illnesses such as oral sepsis, cough, pharyngitis, emphysema and allergic conditions, render the patient more susceptible to complications in the respiratory tract.

The most important influencing factor, however, is the type of operative procedure. Because of the frequent occurrence of pulmonary diseases after operation on the stomach and duodenum, a rather complete discussion of this subject seems desirable. The mortality of these complications varies from 25 per cent to 50 per cent of the patients in whom they occur.

There has never been adopted a suitable appellation of these postoperative pulmonary complications, as there are many different terms employed for the same ailment. Matas refers to them as "postoperative pneumopathies" after the French school; Whipple considers the common complication an aspiration pneumonitis; Cutler considers it as an embolic infarction; whereas Lee, Corrylos, Jackson refer to it as "atelectatic pneumonia." However, the definite clinical course and radiographic findings suggest that these complications may be classified as entities.

Embolism of the pulmonary artery is a late postoperative complication, usually with symptoms which are characteristic: shock, pain and hemoptysis. The signs, course and prognosis will depend upon the size of the artery which is occluded. If it is of considerable size, the lung which becomes consolidated may have a wedge-shaped shadow on the Roentgen film. Small pulmonary vessels are probably involved more frequently than is generally recognized.

Postoperative lobar pneumonia occurs infrequently. It is caused by the pneumo-

coccus which should be typed from the sputum, after which the pneumonia is treated just as the usual medical case of this disease.

Aspiration pneumonia and hypostatic pneumonia occurring after operation are more difficult to diagnose. There may be physical and radiographic signs of consolidation and a typical clinical course; or the signs may be vague and the clinical course rapid. Many of the pulmonary complications do not fit any of the other types named and probably belong in this heterogeneous group.

Massive collapse of the lung occurs in about 1 per cent of operations for gastric cancer. It may be partial or complete. The clinical symptoms and signs with characteristic *x*-ray findings make the diagnosis less difficult. There is considerable evidence that atelectasis occurs more frequently in the lung postoperatively than does a real pneumonic process. It has been shown that chest expansion is reduced 75 per cent after abdominal operations; supero-inferior diameter of the thorax is greatly diminished due to marked elevation of the diaphragm. In 75 per cent of the patients with no clinical evidence of pulmonary complications, Muller, Pendergrass and Overholt found an increased density of the trunk shadows producing a triangular area of density in the lower lobe. The vital capacity following abdominal operations has shown a reduction of 64 per cent of the preoperative or normal values in a series of 218 patients. Churchill and McNeall, Head and Powers have made similar observations.

In addition to the factor of pulmonary hypoventilation in the production of pulmonary atelectasis, the factor of bronchial obstruction is also important. Lee, Jackson and Coryllos believe that postoperative pneumonias develop in atelectatic portions of the lung produced by bronchial obstruction. In allergic patients, due to the physical shock of the surgical procedure or the protein shock of the extravasated blood or bacteria, excessive bronchial secretion added to the edema of the mucous membrane or bronchial spasm results in obstruction. This obstruction is not completely relieved by coughing, since the cough reflex is usually abolished or diminished by narcosis. Therefore, it continues and the secretion becomes more viscid. There is said to be a ball-valve action, allowing the escape of air with expiration, but no entrance with inhalation or complete plugging with absorption of the confined gases. The rapidity with which atelectasis becomes complete depends on the mechanism and the percentage of oxygen in the confined air, as it is absorbed more rapidly than nitrogen.

In the treatment of pulmonary complications, several prophylactic measures are adopted. The first, of course, is to avoid the predisposing factors. The routine postoperative use of a mixture of 7 per cent to 10 per cent carbon dioxide with 90 per cent to 93 per cent oxygen, has been generally accepted and utilized. It is our practice to administer this mixture of gases every two hours during the first thirty-six hours following the operation, except when the patient is sleeping and even more frequently during the first eight to ten hours. The gas is given in sufficient quantities to cause hyperpnea. It is also advisable to institute deep breathing exercises as soon as the patient can coöperate. Other prophylactic measures are the avoidance of excessive narcosis, the avoidance of tight-fitting bandages on the upper abdomen, frequent change of posture of the patient and the prompt relief of abdominal distension. When such complications do occur, oxygen inhalations are doubly indicated. The great value of bronchoscopy and direct bronchial aspiration through this instrument is so generally recognized that it need not be stressed.

SHOCK

This term is quite generally believed to be unsatisfactory, but a suitable substitute has not been found for the clinical syndrome that is familiar to all, the confusion being due: first, to the obscurity of the cause of shock, and second, to the usual

failure to differentiate between primary and secondary shock (termed psychogenic and neurogenic by Phemister). The typical picture of this condition is a rapid and thready pulse, rapid and shallow breathing, loss of motor reflexes and a lowered basal metabolism, giving a subnormal temperature.

In primary shock or collapse, Goltz found that the essential change was vasodilatation, due to reflex cardiac and vasomotor paralysis. The lowered blood pressure may persist from a few minutes to an hour or more, after which recovery may take place spontaneously, or following the administration of drugs. There is little or no change in blood volume. If recovery does not take place, the patient passes into secondary shock.

In secondary shock, the profound circulatory depression is not due to heart failure, nor is it due to vasomotor paralysis, since it has been shown experimentally that the vasomotor reflexes are normal during shock, and there is often no cardiac disease. The blood shows a relative increase in hemoglobin content and higher viscosity, with diminished volume in the blood vessels, and diminished alkaline reserve. A clinically analogous condition is found in histamine poisoning, which is known to paralyze the capillaries in a state of dilatation while constricting the arterioles. The dilated capillaries are more permeable than normal and fluid containing serum protein is lost into the tissues, resulting in diminution of blood volume with increased viscosity. A lowered alkaline reserve or slight acidosis results from impaired oxidation in the tissues. It is not great enough in amount, as a rule, to produce detectable edema. The site of the capillary dilatation is not known; the skin is very pale, definitely excluding the peripheral capillaries, and the splanchnic vessels are not found engorged during operative procedures when shock supervenes. The best explanation at present seems to be that the concentration is in the skeletal muscles or else that the loss is only in "effective blood volume."

Although this mechanism and these findings are generally accepted for the condition termed shock, the etiologic factor or factors are much disputed by experimental workers and probably there are various forms with different specific causes. The acceptance of histamine or a toxin as the possible cause in most cases is not general, although Cannon has warned against discarding this theory altogether. There are various contributory factors that may be partly responsible for the production and maintenance of shock. Among these may be mentioned starvation, dehydration, exposure to cold, unusually prolonged anesthesia, excessive loss of blood, infection and trauma.

The treatment is first and foremost to avoid the predisposing causes. The curative treatment cannot be specific because the cause is not known. Therefore, one may attempt first to replace the blood volume and, second, to produce capillary constriction. Blood is the best solution to replace the volume of circulating fluid as it replaces the lost serum protein and is less rapidly diffused from the dilated capillaries. Other colloid containing fluids such as gum acacia and gelatin solutions have been considered the next choice. Acacia is now available in a refined form and in convenient containers for intravenous use as prepared by several of the larger drug houses. It is usually administered in amounts of 300 to 600 c.c. of a 6 per cent solution. It cannot be added to citrated blood as clotting would occur. Erlanger and Gasser have shown that acacia solution reduces the plasma loss, but it has been reported that it may cause damage to the liver.

Saline solutions are of little value, since permeation of these fluids through the capillaries will lead to further interference with oxidation in the tissues. Sodium bicarbonate solutions have been used because of the associated acidosis in shock; but they are dangerous because an uncom-

pensated alkalosis may result. Ten per cent glucose solution, even though the effect of its hypertonicity is temporary, is probably the best solution to replace blood volume if acacia or gelatin solutions are not available. Frazier has reported beneficial results from the administration of 10 per cent ethyl alcohol in 10 per cent dextrose, given very slowly intravenously. He states that 2 liters may be given in twenty-four hours, and that the patient experiences a feeling of warmth and well-being. The application of external heat and lowering the head are general measures that hardly require mention.

Drugs that are known to act as vasoconstrictors, such as adrenalin or pitressin have no value in doses which can be used safely. A temporary rise in blood pressure which may be produced may be followed by a worse depression. Adrenal cortex or cortin has been reported by Andrus and Heuer to give encouraging results. Caffeine has very little value as a stimulant in this condition.

If anesthesia has played a rôle in producing the state of shock and respiration ceases, it must be remembered that the normal stimulus of respiration is not the lack of oxygen, but the presence of carbon dioxide. With rapid respiration, the carbon dioxide is eliminated from the blood stream, and acapnia as described by Yandell Henderson, will be present.

OTHER COMPLICATIONS

Hiccough. Hiccough or singultus is due to a clonic spasm of the diaphragm. When it occurs postoperatively and is persistent, it is not only a great discomfort, but an alarming symptom. It occurs most frequently when the abdominal viscera and their peritoneal coverings have been disturbed or irritated. It may appear as one of the first signs of acute dilatation of the stomach. The afferent impulses are carried by the phrenic nerve and the sympathetic trunks. It seems to occur more frequently in females, often over 45 years of age.

The treatment is sometimes difficult. Gastric lavage and continuous gastric drainage may be beneficial. Morphine in large doses will usually aid in causing sleep, with abatement of the hiccoughs. If it is severe, no foods or fluids are allowed by mouth. If these methods fail, and the symptoms become intractible, either injection of the phrenic nerve with alcohol or exposure of the nerve and slight squeezing with the hemostat, may be used as a last resort to maintain life. A test of the effectiveness of this procedure is to inject the phrenic nerve with novocaine to see if there is an immediate but temporary abolition of the hiccoughs.

Parotitis. Parotitis is a distressing and often fatal complication following operation for gastric cancer. After it appears, the progression from an acute inflammation of the acini of the gland to suppuration occurs very rapidly, since the debilitated state of the patient offers no barrier to the infective agent.

Three predisposing factors can be considered and eliminated in part. Parotitis occurs more frequently in patients who are dehydrated; therefore, this condition should not be permitted to develop during the postoperative state. The incidence of this complication increases with patients who are not ingesting liquids by mouth, and consequently there is a tendency for stagnation of salivary secretion. A certain degree of stomatitis often develops in patients who have been on a long continued liquid diet.

As a prophylactic measure, salivary secretion may be induced by giving the patient lemon peel to chew three or four times daily. When the parotitis develops, the early institution of radiation therapy, either with radium or Roentgen rays, may be of definite value in aborting the infection. Repeated suberythema doses are administered. Large doses of potassium iodide are indicated. In some instances, it has been found worth while to cannulize Stenson's duct and irrigate with dilute acriflavine or Dakin's solution.

Acute Dilatation of the Stomach. This complication may occur after any operation on the stomach, usually during the first forty-eight hours. The occurrence of hiccoughs, an unusually rapid pulse, upper abdominal distention, regurgitation of fluid, loss of desire for water, and peculiar facies may indicate the presence of this condition. It is most important that it be recognized early. The stomach will usually contain an amount of fluid which is far in excess of the fluid intake; it practically always contains bile and little or no hydrochloric acid. If this fluid is removed, and the stomach lavaged until the fluid return is clear immediately after recognition of the complication, there is rapid recovery. No fluids should be given by mouth. Morphine for the induction of sleep in helpful. Change of posture to relieve the pressure on the superior mesenteric artery has been advised. A Levine tube introduced through one nostril is left in place to provide continuous drainage and decompression of the stomach for at least twelve hours. Prostigmin or eserine is given hypodermically every three hours for three or four doses.

Postoperative Gastric Hemorrhage. This complication occurs early, usually within the first forty-eight hours after gastric resection. It is manifested by an appreciable amount of bright red blood in the vomitus. After morphine has been given to assure rest and allay nervous excitement, the organ must be evacuated of its contents and put at rest also. Repeated lavage with water at 120°F. has been advised by Young and Fowler as early as twelve hours after operation. Finsterer and Cunha first attempt to control such bleeding by lavage with ice water, and if this is unsuccessful, they introduce 100 c.c. of 1:1,000 silver nitrate solution into the stomach; this procedure may be repeated only once. The intravenous administration of calcium and the subcutaneous injection of horse serum has been advocated, but are of questionable value. The parenteral administration of fluid, or blood transfusion, permits the replacement of the fluid loss in such complications, but these measures are not carried out, as a rule, until the bleeding has definitely stopped or unless the loss from hemorrhage is alarming.

Postoperative Peritonitis. In the general experience of the abdominal surgeon this complication is the cause of one-fourth to one-tenth of the fatalities after gastrointestinal surgery. It may be due to unavoidable contamination from badly infected gastric contents; on the other hand, it may be due to gross leakage of gastric contents from defective anastomoses, perforation elsewhere in the gastrointestinal tract, gangrene and necrosis from impaired blood supply, or from a suppurative focus in the wound. The best treatment is prevention by careful and prolonged preoperative preparation of the patient, and by meticulous care in the technique of resection and anastomosis. The treatment of peritonitis may be found in any of the general surgical textbooks. In general it depends upon the cause of the peritonitis and the stage and extent of this complication.

Postoperative Diarrhea. Postoperative diarrhea is a distressing complication and, if uncontrollable, may be fatal. The etiology is unknown. It is generally believed to be due to proctitis and colitis. In Beer's experience, the cause may be too large a gastrointestinal stoma, or a localized peritonitis. Anschütz studied this complication in 500 patients who had gastric operations; he found that it occurred early in some cases, but usually on the seventh to the tenth day. The hazard of a fatal outcome is increased if the diarrhea follows the performance of a gastroenterostomy in the absence of free hydrochloric acid in the stomach. Inflammation of the jejunum characterized by irritation of the mucosa may follow too rapid emptying of the stomach.

Bierende studied seven cases with this complication, following various operations, three of which were for ulcer and one for carcinoma of the esophagus. The pathologic changes were chiefly in the rectum and upper colon. At first these changes consisted of small, confluent, hyperemic plaques on

the rugae. Later, desquamation and coagulation necrosis occurred, the fibrin in the necrotic regions giving a honeycombed appearance to the surface. Goldschmidt and Muelleder found postoperative colitis or enteritis occurring in 29.3 per cent of their patients who had gastric operations.

The treatment of this postoperative diarrhea, in its mild forms, is the institution of a simple non-irritating diet and astringent therapy. The administration of large quantities of dilute hydrochloric acid by mouth, together with large doses of opiates, may be necessary. It is possible that the incidence of this complication may be lowered by the avoidance of prolonged preoperative catharsis.

Thrombophlebitis. This complication is not more frequent after gastric and duodenal operations than after other abdominal operative procedures. Nygaard has advised the following measures for prophylaxis; treat varicosities of the legs preoperatively or bandage the legs, avoid fluid enemas, maintain the body heat, encourage exercise of the extremities, elevate the leg on soft pillows, administer desiccated thyroid extract 2 gr. three times daily as soon as tolerated by mouth and continue until the patient is able to get out of bed.

Internal Hernia. This complication is a rare one following gastric resection or anastomosis. Buchanan, however, reported a case in which herniation of the jejunum between the ligament of Treitz and a gastrojejunal anastomosis had occurred. Of the three others reported in medical literature, all had occurred within three weeks after gastroenterostomy. The symptoms are pain, collapse, vomiting of large quantities of bile and other symptoms of intestinal obstruction. The treatment is operative, as soon as the indications are apparent. Preventive measures consist of obliterating the natural fissures by suturing the proximal loop to the lower part of the mesocolon.

Postoperative External Fistulae. Duodenal fistula is a very distressing complication of gastrointestinal surgery because of the digestive activity of the secretions on the abdominal wall. There are two principles of treatment: first the protection of the skin of the abdomen, and second, the neutralization or inactivation of the intestinal and pancreatic juices. The latter procedure is more important; it is accomplished by inserting one or more Dakin tubes into the interior of the wound, even into the duodenum, if possible. Through this tube is instilled by the Murphy drip principle a mixture of tenth normal hydrochloric acid containing Witte's peptone in solution. This neutralization of the alkalinity of the intestinal and pancreatic juices inactivates the strong proteolytic and lipolytic enzymes, so that they are no longer capable of digesting the living tissues of the abdominal wall. The peptone seems to serve as a fixative for the proteolytic enzymes, or a more ready source for their action than are the living tissues. The protection of the abdominal wall is of secondary importance; it may be accomplished by the liberal use of Kaolin or Fuller's earth, or finely powdered copper, or aluminum bronze paint; or by the application of a glue made by evaporating compound tincture of benzoin to the proper consistency. A fistula so treated may heal spontaneously and not require secondary closure. Postoperative gastric fistulae are less troublesome and will usually close spontaneously, providing the stoma previously made is sufficiently large to care for the major portion of the fluid intake.

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RATIONAL POSTOPERATIVE TREATMENT FOLLOWING ABDOMINAL OPERATION

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FOR all practical purposes, the average patient who undergoes an abdominal operation in the ordinary hospital today suffers the same amount of postoperative pain and distress and is subjected to approximately the same postoperative routine as prevailed twenty-five years ago. Judging from a study of textbooks, surgical literature and the "standing orders" of numerous hospitals, there seems to be an almost universal belief among our profession that the performance of a laparotomy brings in its wake a chain of symptoms which cannot be avoided and an amount of suffering which cannot be alleviated. Even very recent articles on the subject of postoperative management emphasize the assumed necessity of withholding water from patients and caution against the giving of food until late in the period of convalescence.

Likewise once or twice yearly some new drug is introduced having for its purpose the early reëstablishment of peristalsis and the prevention or amelioration of gas pains. The very fact that an enormous amount of research on the subject of intestinal motility has been done and that very praiseworthy results have been accomplished in the synthesia of drugs which will stimulate peristalsis is prima facie evidence that paresis of the small bowel with resultant abdominal distention does follow most operative maneuvers and that the usual and ordinary methods instituted for relief fail to accomplish the desired purpose. For the most part, attention has been directed to treatment of these conditions after their onset and but little thought has been applied to means of prevention. It is presupposed by most surgeons that the biochemical and physiologic processes of the postoperative patient undergo a very profound dislocation, and that this abrupt change requires for its correction very special, highly technical and for the unfortunate individual extremely distressing treatment. The lessons learned by medical men twenty years ago in the treatment of typhoid fever, for instance, are entirely disregarded, and for some obscure reasons, tradition and innate conservatism perhaps, are deemed entirely inapplicable to the handling of human beings after the usual run of surgical procedures.

The postoperative regime now in force in the great majority of American hospitals and approved by the bulk of surgeons is a heritage from the days of vigorous purgation, starvation and profound ether anesthesia. Perhaps twenty-five or thirty years ago when no reliable anesthetic agents save ether and chloroform were available, when preoperative preparation consisted of starvation plus castor oil, when every deep ether anesthetic was followed by from twenty-four to forty-eight hours of severe nausea and vomiting, when abdominal distention and severe gas pains followed all operative procedures within the abdomen, there may have been valid reasons for the drastic purgation, starvation or semi-starvation and frequent rest-disturbing enemata which followed every operation. However, in these modern times, with knowledge of proper, scientific preoperative preparation widely disseminated among the profession, with the wide choice of effective anesthetics and a better understanding of their uses and limitations, coupled with universal acceptance of the value of gentle, delicate, well planned technical maneuvers, there are no logical reasons for denying the unfortunate pa-

tient the opportunity to profit from this accumulated knowledge and to enjoy a smooth, uneventful convalescence.

While the hospital stay will probably never be exactly pleasurable, surgical progress together with humane feeling demand that the recovery period be so managed that an indelible impression of misery and suffering is not recorded on the patient's memory. Considering the matter from the purely practical and self-interested viewpoint of the surgeon who desires to extend the ministration of his art to the greatest possible number of persons requiring his care, there can be no reasonable doubt that accounts of severe pain and discomfort which have been widely spread among the lay public have prevented or postponed many badly needed operations and indirectly brought about numerous untimely deaths.

Severe criticism of long established customs and usages is not justified unless alternative and perhaps superior methods are suggested in their places. It is our intention, therefore, to set up certain standards by which good postoperative treatment may be measured and to discuss means by which, to our own satisfaction at least, we have been able to approach these objectives. For purposes of discussion, the following fundamental criteria are suggested:

1. There should be very little postoperative pain.
2. No abdominal distention or gas pains should be present.
3. Peristalsis should be quickly reëstablished.
4. The patient should regain entirely or closely approximate his preoperative weight before leaving the hospital.
5. There should be early restoration of muscular vigor and economic self-sufficiency.

With modern methods and particularly by careful attention to proved principles of normal physiology, it is now perfectly feasible to so manage the ordinary laparotomy that the main complaint of the patient during convalescence will be the pain and discomfort directly referable to the incision. Needless to say when the patient is troubled only by the comparatively unimportant factor of soreness in the recent wound, the surgeon is relieved of many anxieties which ordinarily harass him and disturb his peace of mind for the first few days following any surgical procedure. Incidentally much of the soreness in the ordinary wound can be avoided if heavy tension sutures are not used and interrupted black silk is employed for fascial closure, as heavy stitches invariably cut their way partially through skin and muscle and are a fruitful source of pain.

Temperaments and conditions vary and the surgeon must ever be ready to meet situations as they arise and to discard preconceived ideas. Always bearing in mind that human beings are not standardized and that the most carefully thought out routines frequently fail in their application to sick individuals, our plan is about as follows.

Water, hot, cold or from the tap, according to the patient's taste, is given immediately after consciousness returns and in such amounts as may be desired. Likewise a high caloric, protein-rich diet is advised very early. With gentle technical maneuvers and modern anesthetics, nausea and vomiting are becoming very rare, and as a result of these facts, a tray is presented the evening of the operative day and the patient is urged to eat some bread, toast, wafers, jello, breakfast foods or similar easily digested articles. Slight nausea and moderate vomiting are not feared as these function as automatic gastric lavage and obviate the necessity for use of Levine tubes, continuous suction, etc.

When the anesthetic employed has been ethylene cyclopropane or spinal, water is usually permitted orally within thirty minutes of the time patient returns to his room. With the use of ether by the open drop method, the ordinary individual will call for and retain water by mouth within one to three hours. Enough morphine or

pantopon is allowed during the first two or three days to prevent undue pain. Following the first night, a sedative selected from the barbital group is prescribed for oral use to produce sleep and quiet restlessness. The barbiturate, of course, reduces the amount of opiate required.

Fruit juices, and in particular orange juice, are sternly prohibited as it is well known that they possess little caloric value and unquestionably tend to produce excessive amounts of intestinal gas. Fine and Levenson have clearly shown that of all the commonly employed foods which form a part of the ordinary hospital liquid diet, orange juice and milk will form the largest amount of flatus. At no time is the usual hospital liquid diet prescribed as we believe that such a menu furnishes an insufficient amount of fluid, contains but very little energy measured in calories, and in our experience always leads to the production of abdominal distention with accompanying gas pains.

The fluid intake and output should be carefully estimated as considerably more water is needed to maintain systemic balance than is generally realized. Various workers have computed the loss through perspiration and respiration as somewhere between 1,000 and 2,000 c. c., and the urine and bowel discharges will account for a similar amount. Eminent physiologists and clinicians have asserted that the intestinal juices in the normal adult will reach the imposing volume of 3,000 to 4,000 c. c. every twenty-four hours. During the operation itself somewhere between 500 and 2,000 c. c. is lost through sweat, through the breath and in the bleeding which occurs. This figure depends, of course, upon the duration of the anesthesia and the severity of the operative interference. It, therefore, must be remembered that during the first day or two, if possible, the amount lost in the operating room plus the normal requirements of the adult must be supplied, and in actual bedside practice, this means that at least 3,000 c. c. must be ingested with the food or as plain water. As a matter of clinical observation, it is fairly well established that the coöperative and intelligent patient will quickly reëstablish his water balance if allowed access to a pitcher and glass and permitted to drink the amounts which his system demands.

Besides water, large amounts of chlorides are lost on the operating table and in the bodily discharges, and the systemic reserve of glucose is depleted. Insofar as the chlorides are concerned, their diminution is compensated for through intake in the food with subsequent retention, while the glucose requirements are met through the ingestion of readily assimilable carbohydrates. Since the normal channels for the reception of these items are utilized, their assimilation and retention is more effective than if they are introduced by unnatural routes.

The early ingestion of easily handled solid foods plus ample water makes it unnecessary, except under unusual circumstances, to prescribe glucose and saline solutions by the subcutanious, intramuscular and intravenous routes. Avoidance of the pain caused by the insertion of needles for hypodermoclysis or venoclysis is greatly appreciated by the patient and, by adding to the number of hours he may rest in comparative comfort, greatly assists in his earlier recovery. Likewise it should never be forgotten, as has been shown by Fantus, that fluid given by mouth exerts a much greater diuretic effect than when administered intravenously. The natural channels for the reception of food and water are incomparably the most efficient. According to many authors the incidence of venous thrombosis and pulmonary embolism has doubled in the past twenty years and it is reasonable to assume that much of this increase is due to the more or less routine employment of hypertonic solutions.

The subject of intestinal gas has long interested surgeons and physiologists and many theories have been propounded to explain its occurrence. Certainly it is generally agreed upon that both in health and disease considerable amounts of air,

nitrogen, carbon dioxide, ammonia and methane are found in the bowel. There is no unanimity as to their origin as many writers feel that the air is swallowed, others call attention to the well known exchange of gases between the blood and intestinal mucosa with the comment that this is a two-way process, while still others blame fermentation and putrefaction resulting from bacterial action. Regardless of theoretical considerations, the facts remain that large amounts of gases form in health and much larger amounts when there is interference with intestinal motility from various causes. The combination of starvation plus operation is the one with which we are most vitally concerned at present.

In our early attempts fifteen years ago to feed patients early after operations we were greatly troubled by the problem of intestinal gas and abdominal distention. The first success attended our efforts after we banished the pitcher of orange juice which was formerly part and parcel of every hospital room immediately after operation. This simple maneuver produced encouraging results. Since that date excellent scientific work, in particular that of Fine and Levenson, has shown that orange juice is readily fermentable and produces truly enormous quantities of gas. My attention was then directed to the clinical observation that healthy persons who go on reducing diets almost always select what really amounts to an ordinary, hospital liquid diet and that they invariably suffered from gaseous distention. The next step was to eliminate entirely the liquid diet and to prescribe solid food at once. Further diminution of gaseous distention and increased comfort was obtained. However, it was still necessary to make use of pituitrin and other drugs and to employ frequent enemata in order to stimulate peristalsis.

From observation of the practices of internists in their handling of colonic stasis, it was assumed that an adjuvant which would furnish bulk, supply lubrication and possess laxative qualities would be highly desirable. Mineral oil in agar, with or without the addition of small amounts of phenolphthalein best suited these specifications and has been employed routinely in 1 ounce doses three times a day whenever tolerated. As all clinicians are aware, there are some few individuals who will not or cannot take mineral oil. In the event the patient registers no objection to the oil and agar mixture, the bowels will move easily and without appreciable distress on the afternoon of the third or the morning of the fourth day. Rarely will enemata be necessary and small amounts of flatus which may develop are readily taken care of by means of the rectal tube. Once the first bowel action has occurred, the dosage of the oil and agar mixture can be gradually reduced to the point where one or two movements take place daily without troublesome leakage. Immediately following the first action of the bowels, the hospital general diet is prescribed with the idea in mind of restoring the weight level to the same figure, or at least very close to it, as on the day of admission.

Free and unrestricted movements in bed are likewise quite helpful as they tend to promote good circulation thus diminishing the possibility of emboli, and most important of all, assist in restoring the patient's self-confidence. Enemata are but rarely required or employed as they tend to wash out the normal protective coating of mucus on the lumen of the bowel and thus probably aid in producing colonic stasis with accompanying gas formation. It is even possible that instances of colitis of varying grades of severity may be attributable to the injudicious use of irritant enemata during convalescence.

Most patients receive far too much treatment and over-solicitous attention. Rest is the most valuable weapon in the surgeon's armamentarium and the most often overlooked. The normal reparative mechanism of the human body is truly amazing and should be permitted to work its miracles unhampered by unnecessary or even harmful therapeutic maneuvers. Nurses need careful and tactful instruction,

if the above outline régime is in force, as from past experience and training they are likely to feel that they are not doing their full duty unless both they and the patient are kept very busy.

The type of management described has been applied to appendectomies, cholecystectomies, stone in common duct, early mechanical obstruction, herniotomies and various types of pelvic surgery. It has not been used in severe intestinal obstruction, major gastric operation, malignancies, general peritonitis, and is not indicated when abdominal distention is present when the patient is first seen by the surgeon. However, as mentioned before, the plan is applicable to by far the majority of operations performed by the trained individual. The method will probably fail in the hands of the surgical tyro or occasional operator because of faulty preoperative preparation, rough handling of tissues or improper evaluation of the surgical risk involved. So far the patients, for the most part, have been first class surgical risks.

Approximately 350 patients have been given the above described dietary management and sixty-eight have been given mineral oil emulsion. There were four instances in which the mineral oil therapy had to be abandoned.

The advantages accruing were the comparative freedom from pain, absence of distention or gas pains, increased cheerfulness, excellent appetite, and most important of all, the early reëstablishment of normal weight and quick return to ordinary duties. Several individuals actually gained weight while in the hospital. Avoidance of the use of glucose and saline solutions appreciably lowered the hospital costs and thus relieved economic distress. A great deal of the present agitation with regard to high hospital costs can be allayed by general adoption of these methods. Less nursing is likewise needed and this also does wonders to help the financial situation.

In the course of our investigations, it was observed that several patients lost very little weight following major surgical procedures, and about two years ago it was determined wherever possible to record accurately the pre- and postoperative weights. While it was not always feasible to weight all patients since some operations are emergencies, some patients returned home before becoming ambulatory, etc., we now have accurate observations on some forty-three individuals. A list of these is given below

Operation	No.	Gained	Lost	No Change	Average Loss, Lb.
Appendectomy	17	3	13	1	3
Cholecystectomy	10	2	7	1	2½
Salpingectomy	3	..	3	..	3
Herniotomy	3	1	1	1	½
Common duct obstruction	1	..	1	..	3
Uterine suspension	1	1	..	..	2
Duodenal ulcer ruptured	1	..	1	..	4½
Hysterectomy	7	..	7	..	2½
Laparotomies	43	7	31	3	

There are no statistics in the literature, at least none which were available to us, showing the average loss of weight following abdominal operations, but it is our impression that the decrease under usual methods of management is somewhere between 7 and 15 pounds.

There were four failures of this mode of treatment either through inability to take mineral oil or lack of appetite. One man who refused to take mineral oil emulsion and would not eat until the sixth day after the removal of a midly inflamed appendix lost 17 pounds. The wife of a physician who desired a reduction in weight, without our knowledge deliberately selected foods of low caloric value and showed a loss of 8 pounds on the tenth postoperative day. However, there was no distention or gas pain. Two rather nervous young women who underwent pelvic surgery refused to eat or to take mineral oil.

Table 1 shows the details of management of the forty-three patients.

TABLE I

Age	Sex	Operation	Anesthetic	No. Enemata	Day Bowel Moved	Weight Preop.	Weight Postop.		Loss	Gain
							Day	Pounds		
30	F	Appendectomy Removed ovarian cyst	Cyclopropane	0	3	120	10	122	0	2
38	M	Appendectomy	Ether	0	3	180	13	176	4	0
44	M	Appendectomy	Ether	0	3	192	11	187	5	0
50	F	Cholecystectomy	Ethylene	0	4	142	14	142	0	0
42	M	Appendectomy	Ethylene	0	3	220	7	222	0	2
47	M	Explored bile ducts Freed adhesions	Ether	2	5	225	2	222	3	0
44	F	Cholecystectomy	Ethylene	0	3	132	10	136	0	4
50	M	Appendectomy	Ethylene	0	3	162	10	160	2	0
38	F	Hysterectomy Supravaginal cervical cauterization	Ethylene	0	4	114	11	111	3	0
50	F	Appendectomy	Ethylene	0	3	136	10	135	1	0
52	F	Cholecstectomy	Ethylene	0	4	154	14	149	5	0
39	F	Ruptured pyosalpinx Uterine fibromyoma	Ethylene	1	3	146	12	145	1	0
42	F	Hysterectomy Supravaginal cervical cauterization	Ethylene	0	4	138	12	136	2	0
20	F	Appendectomy	Ether	0	3	118½	14	115½	3	0
28	M	Appendectomy	Ether	0	3	158	13	160½	0	2½
4	M	Ferguson hernia repair Jaboulay hydrocoele operation	Ether	0	3	39	8	38	1	0
55	F	Cholecystectomy	Ethylene	0	4	116	12	112	0	4
24	F	Appendectomy	Ethylene	0	3	157	6	156	0	1
28	F	Appendectomy	Ethylene	0	3	150	11	152	2	0
4	M	Ferguson hernia repair	Ether	0	3	45	14	45	0	0
43	M	Appendectomy Freed colonic adhesions	Ethylene	0	3	138	9	141½	3½	0
35	F	Appendectomy Supravaginal hysterectomy	Ethylene	0	4	238	10	236	0	2
43	F	Studdiford perineoplasty Supravaginal hysterectomy Cervical cauterization	Ethylene	1	5	125	13	122½	0	2½
22	F	Appendectomy Salpingectomy right Ovarian cyst right	Ethylene	0	4	116	14	112	0	4
11	M	Appendectomy	Ether	2	5	82	10	82	0	0
56	F	Cholecystectomy	Ethylene	0	3	125	9	122½	0	2½
6	M	Bassini hernia repair Circumcision	Ether	0	3	53¾	4	54	¼	0
38	M	Appendectomy	Ethylene	0	4	158	6	154	0	4
55	M	Perforated duodenal ulcer	Ethylene	1	3	160	9	155½	0	4½
61	F	Cholecystectomy	Ethylene	1	4	177	10	174	0	3
37	F	Appendectomy	Ethylene	1	4	136	11	132	0	4
59	F	Cholecystectomy	Ethylene	3	5	153	10	150	0	3
23	F	Appendectomy Baldy-Webster uterine suspension	Ether	0	3	125	10	124	0	1
28	F	Removal of ovarian cyst	Ethylene	0	4	118	10	120	2	0
50	F	Cholecystectomy	Ether	0	4	155	9	155½	½	0
38	F	Cholecystectomy	Ethylene	0	4	127	11	125	0	2
31	F	Supravaginal hysterectomy	Ethylene	0	4	104	8	101½	0	2½
38	F	Supravaginal hysterectomy	Ethylene	0	4	114	10	110	0	4
50	F	Supravaginal hysterectomy	Ethylene	0	4	168	10	164	0	4
24	F	Salpingo-oöphorectomy right Salpingectomy left Appendectomy	Ether	0	5	106	8	101	0	5
35	F	Bilateral large chocolate ovarian cysts	Ethylene	0	4	124	10	122	0	2
43	F	Cholecystectomy	Ethylene	0	3	153	9	150	0	3
28	M	Appendectomy	Ether	0	2	148	6	144	0	4

SUMMARY

Present day postoperative treatment leaves much to be desired.

Fundamental criteria of good management are suggested.

A simple routine is suggested. Early feeding of solid food with high protein and caloric value has been used in over 350 laparotomies.

Mineral oil with phenolphthalein has been employed sixty-eight times with four failures.

Forty-three patients whose weights could be carefully checked show an average loss of approximately 3 pounds. Seven patients

actually gained weight and three showed no change.

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SURGICAL CONSIDERATIONS OF TEMPERATURE IN LIGATED LIMBS

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SEVERAL recent papers have described certain phases of the writer's observations on local asphyxia produced by applying rubber tourniquets to various parts, particularly the limbs, of several warm-blooded species.[1] Locally, the tissues are able to tolerate much longer periods of absence of circulation than supposed by the average surgeon. The systemic effects constitute an ideal form of experimental secondary shock, which can be fairly accurately standardized in different grades of severity according to the mass of tissue ligated and the length of time. By this method, indirect evidence was obtained which seems to favor the toxic theory of the causation of secondary shock. The present paper will add observations on the modifying influence of temperature, with suggestions concerning possible applications in surgery.

SURVIVAL TIME AT ROOM TEMPERATURE

Experiment. The right foreleg of a dog was tightly ligated a short distance above the wrist for fifteen hours at room temperature. Light amytal narcosis was used at the beginning, when the tourniquet was obviously a source of discomfort. By the time the narcosis passed off the ligated part of the leg was cold and the dog paid no attention to it, so that he could be left free and unmuzzled; the animal ate and drank plentifully. The leg became hot and swollen within fifteen minutes after release. It was paralyzed and without sensation. Within a few hours the edema extended above the elbow, and there was slight blood-tinged oozing through the skin between the toes. All these effects subsided during the following days, without ulceration or permanent disability.

A blood count just before release of the tourniquet showed red cells numbering 6,350,000. A second count at the height of edema three hours after release showed: red cells 5,300,000, leucocytes 31,000. The ligation of a forefoot for fifteen hours was thus unable to produce constitutional symptoms of shock, and the edema of one foreleg failed to cause concentration of the blood in a strong dog able to eat and drink normally.

Wilson and Roome,[2] who took special care to assure complete stoppage of circulation, found no gangrene in dogs' legs after as long as twenty hours of ligation. Their animals did not live long enough for them to make sure that the legs might not have been lost secondarily through thrombosis or ulceration at the zone of ligation, though the tissues distal to the ligation zone seem able to endure probably more than fifteen hours. The wing of a chicken has survived nine hours of ligation, and the actual limit may be still longer. Among other variables, the activity of tissue metabolism may be one cause of differences in resistance to asphyxia in different species. This factor must also be affected by temperature.

LIGATIONS AT ELEVATED LOCAL TEMPERATURES

Unanesthetized rats were comfortably immobilized, with a ligated hind leg projecting through a hole in a board into a water bath or hot air chamber. The close fitting of the leg in the hole and other precautions prevented any appreciable heating of the body, and the absence of fever was proved by frequent rectal temperature readings. The temperature of the water or air chamber was regulated within

a range of approximately one degree during the experiments.

Accepting 47°C. as the approximate temperature of beginning heat coagulation in mammalian muscle, and considering the probability that the interior temperatures of the leg were not quite so high as that of the bath, the experiments were begun with water between 46° and 47°C. One hour of such ligation resulted in the death of rats within one hour after release. Ligations of only fifteen to thirty minutes sufficed to cause gangrene of the leg, with or without subsequent death of the animal.

A series of experiments was then performed with descending gradations of temperature. On account of the two variables determining survival, namely temperature and time, the number of such experiments had to be large. The greatest obstacle to precision was encountered in a third variable, namely the different resistance of different portions of the leg. The feet, and particularly the toes, were much more sensitive than the upper leg, evidently because of the lack of hair, the thin delicate skin and the smaller diameter, permitting freer penetration of heat. Therefore vesication and sloughing beginning in the toes or feet sometimes extended upward so as to cause final loss of the leg, although the upper tissues seemed to have survived the primary damage. A modified procedure—coating the feet with some protective substance—was not carried to any consistent conclusion. The results obtained with the unmodified method were as follows:

In water at 45°C., ligation of the entire hind leg for thirty minutes was fatal. These deaths occurred within two or three days, without gangrene or stripping of the skin or hair, but with bright pink hyperemia of the foot and large edema extending up into the flanks. Ligations below the knee, which did not cause fatal shock, were tolerated by the local tissues nearly up to one hour. Periods between one and one and one-half hours caused necrosis, usually developing gradually in the course of a day or two and ending in spontaneous amputation or death.

In water between 42 and 43°C., fatal shock developed after one and one-half hours, and with lower ligations the survival limits of tissues were about the same.

In water between 40 and 41°C., fatal shock could be produced in two to two and one-half hours, and with lower ligations the survival limits of tissues were about three to three and one-half hours.

In water between 38 and 39°C., fatal shock was produced within two to two and one-half hours. With lower ligations the survival limit for tissue was not established positively, but was probably about four hours.

The results with warm air were less satisfactory, presumably because of the poorer penetration of this form of heat. The tolerance limits were not accurately established, but were always reduced to a fraction of the known limits at room temperature.

In representative animals, the supposition that the cause of the acute deaths was secondary shock was tested by blood counts during the ligation and subsequently up to death. The red cell counts were found to rise by two to three million, while at the same time the emptiness of visible blood vessels indicated a diminished blood volume. The rectal temperature during ligation was usually 99 to 100°F. in quiet animals, and exceptionally rose to a maximum of 101.2 with struggling or other disturbances. Development of shock was accompanied by the rapid extreme fall of temperature which is particularly characteristic of small animals—down to 94–96 in the mild degrees which ended in recovery, and down to 90 or lower in severe fatal cases.

It is astonishing to find such destructive effects of slight elevations of temperature, in a water bath which feels only comfortably warm to the hand. The appearances rather strikingly resemble ordinary burns; particularly, the erythema, vesication and necrosis of limbs asphyxiated for

a short time a little above 40°C. give an appearance which is scarcely distinguishable from that of normal limbs dipped briefly into boiling water. That this resemblance is more than superficial is indicated by clinical experience of the ease with which tissues of poor vitality or circulation are burned at comparatively low temperatures. The writer witnessed one case of an arteriosclerotic diabetic whose feet were severely blistered in a Turkish bath which felt comfortable to him and his companions. Temporary ligation of limbs is one standard method of producing shock, and burns are another well-known method. It is interesting that the two methods meet in these experiments, and that their effects in producing both local tissue changes and constitutional shock become added to one another.

Normal tissues have a considerable protection against heat in their blood flow, which acts as a cooling system. That this is not the chief explanation is shown by the fact that asphyxiated tissues show rapid necrosis at temperatures well within the range of fever which normal tissues can tolerate for days or weeks. Evidently the raised temperatures, by accelerating local metabolic or autolytic processes, create increased needs for a supply of oxygen and food and for removal of toxic waste products, and, without circulation, tissue death is thus hastened. In harmony with this interpretation is the behavior of the nerves, which degenerate more rapidly (as judged by paralysis and anesthesia) at elevated temperatures than at room temperature.

One school of investigators finds a satisfactory mechanical explanation of shock in the vasodilatation and fluid exudation resulting from both asphyxial and thermal injuries. Obviously, the accumulation of toxic substances in the ligated tissues, occurring at increased rates at higher temperatures, harmonizes equally well with the chemical or toxic hypothesis.

LIGATIONS IN FEBRILE ANIMALS

Rats, comfortably immobilized in individual well-ventilated boxes, were placed thus in a warm-air chamber. Immobilization was necessary because muscular activity was found to be the chief cause of irregular temperatures and dangerous hyperpyrexia. Brief removal from the chamber every fifteen minutes for taking rectal temperatures did not noticeably alter the course of the fever. At the end of the experiment, milk was fed or 10 c.c. of physiologic saline was injected subcutaneously. Rectal temperatures between 104° and 106°F. could be tolerated without danger for about one hour, or 103° for three or four hours. The oven temperatures for this purpose were mostly between 33° and 35°C. The rectal temperature always fell to normal or subnormal levels within one-half to one hour after removal from the oven. The results with this crude method were too variable for accurate standardization, and there was only the general demonstration that the limits of tolerance, as regards both survival of the local tissues and constitutional shock effects, are much shorter than when the legs are ligated at room temperature.

LIGATIONS AT REDUCED TEMPERATURES—SHOCK

Unanesthetized rats were prepared in practically the same way as for the experiments with local heat, and the ligated legs were immersed in ice-water to a level barely above the tourniquet. Precautions were used to prevent wetting the body and to maintain body warmth. By occasional stirring, the mixture of ice and water immediately adjacent to the leg was kept at approximately 2°C.

Mention has been made elsewhere of the reduction or abolition of shock under these conditions. For example, the high ligation of one hind leg for five hours at room temperature is fatal, but the leg can be safely ligated for more than eight hours in ice-water. The high ligation of

two hind legs for three hours is fatal at room temperature, but in ice-water periods of more than five hours are easily tolerated. The stoppage of aortic circulation by a tourniquet around the lower abdomen for about one and one-half hours proves fatal at room temperature, but by refrigeration of the entire hind-quarters to a level just above the ligature, survival is possible after three hours or more. On account of poor facilities, it was impossible in some instances to prevent the rectal temperatures from falling even lower than in ordinary shock, sometimes to 28° or 27°C. But, contrary to the rule in shock, subsequent warming of the rat allows it to recover readily.

Under these conditions the red cell count is found either to remain approximately constant or to increase within moderate limits. The slightness of the swelling and exudation as compared with room temperature suffices to explain the prevention of constitutional symptoms according to the physical hypothesis. The inhibition of local metabolism furnishes an equally good explanation to upholders of the chemical or toxic hypothesis. It may be added that the nervous degenerations, manifested in paralysis and anesthesia, are much less than for an equal period of ligation at room temperature. If this fact is accounted for by retardation of metabolism in the nerves, the greater damage of motor as compared with sensory nerves still requires explanation.

SURVIVAL TIME AT REDUCED TEMPERATURE

Physiologists are familiar with the preservation of living tissues in the icebox for long periods, sometimes amounting to a number of months. More recently physicians have become acquainted with the preservation of blood by refrigeration for weeks or months, after which it can be used for transfusion like fresh blood. The present experiments were not suggested by the above facts, but grew out of the work with shock. Begun six years ago, this phase of the work was interrupted by so many interfering conditions that it could only lately be carried to the point of publication. These are the first observations of the application of the principle of refrigeration to organs still connected with the animal.

This principle has been used to preserve the ligated legs of rats for periods up to twenty-four hours, with later recovery. Owing to the difficulty of maintaining the body temperature and strength in these small animals, the experiments were continued upon larger species. Other papers[3] describe ligations of the legs of rabbits, cats and dogs at points between the knee and ankle, with refrigeration at about 2°C., for various periods up to fifty-four hours. Similarly, the application of a tourniquet to the lower thigh has been safely endured for as long as twenty-four hours.

No attempt has been made to determine the actual time limits of survival of tissues under these conditions. In practice, the limit is not set by the tolerance of the refrigerated tissues for asphyxia but by the consequences of direct pressure in the zone of the ligature. Though these effects are much less than at room temperature, yet after the longest ligations ulceration commonly occurs in this zone.

The edema and inflammation which develop in the asphyxiated tissues are similar to the results of much shorter ligations at room temperature. The recovery also usually requires less time.

The nearer to the foot the tourniquet can be placed, the better for determining the true survival limits of the local tissues. Ligations above the knee can be tolerated only for a shorter time, and at higher levels in the thigh the periods become still shorter, though always much longer than at room temperature. The reason is obvious in the thickness of the thigh. There is a considerable mass of tissue in the interior, at and below the zone of ligation, which is kept more or less warmed by the adjacent tissues which

still retain circulation and therefore cannot be efficiently refrigerated by the ice-water outside the skin. Accordingly, both local gangrene and fatal shock must result with this crude method if the ligation is prolonged to a period, such as forty-eight hours, which can safely be tolerated with ligations in the thin part of the leg where the refrigeration is more efficient.

APPLICATIONS IN SURGERY

Before undertaking any clinical application of the principle, it would be well for surgeons to convince themselves by trials in animals that ligation and refrigeration for five hours or longer is not only harmless but also inhibits local tissue damage and general shock. Theoretically at least, the following possible uses may be suggested:

1. As mentioned elsewhere, this method has actually been employed for amputation in a few cases of diabetic gangrene. The use of a tourniquet, which has always been forbidden in such conditions, has not thus far created any trouble at the reduced temperature, even with badly sclerosed vessels. There has not yet been opportunity for a sufficient number of trials to decide the advantages and disadvantages as compared with ordinary anesthesia. The experience only proves that amputation can thus be performed in the human subject without pain or shock, and that the wounds can heal satisfactorily. It is hoped that the anesthesia of protoplasm may have some superiority over the mere anesthesia of nerves, and may be serviceable, especially in cases of bad operative risk on account of poor general condition. It must be emphasized, however, that the method is strictly in an experimental stage and its advisability is not assured.

2. For emergency purposes this plan can be recommended more positively. Occasionally there are accidents in isolated localities, and on a larger scale there are military emergencies, as for example recently in Spain or China, when anesthetics may be lacking or surgical care may be delayed. If ice is available, the tourniquet and refrigeration can be applied by anybody of reasonable intelligence. Hemorrhage and pain are thus stopped, and both the local tissue damage and the systemic shock which result from prolonged ligation at ordinary temperatures are abolished. Theoretically a limb might be preserved in ice-water or cracked ice for twenty-four hours or more, especially if the ligation is not too high, but it is safer to limit the time to five or six hours if possible. In this way an overworked military surgeon might, after attending to the most urgent cases of body wounds, find all his limb cases comfortable and ready; he could proceed with the necessary amputations or repairs without the delay of anesthesia or hemostasis, and after removal of the tourniquet could depend upon satisfactory circulation and healing.

3. Even under ideal conditions, there are instances in which a surgeon performing a plastic or other tedious operation may wish to keep a limb bloodless for several hours. As mentioned elsewhere, the unnecessary fears in regard to such a stoppage of circulation arise essentially from two causes: (1) paralyses and contractures may be caused by an improper tourniquet, i.e., one that is too tight, wide or inelastic; especially, a narrow rubber tube is less painful and less damaging than the broad compression which surgeons have favored without evidence; (2) all local tissue damage is accentuated in proportion as the temperature is elevated. A limb that is to be kept bloodless for any considerable period should therefore at least be chilled with icebags. Plastic and other results can be improved by the better preservation of tissue vitality.

4. When a limb is deprived of circulation through an accident, such as a wound or embolism, the procedure must depend upon the degree of deprivation. If there seems to be enough remaining blood supply to keep the tissues alive, the use of warmth to dilate the remaining vessels may be rational But if no such hope exists, as for example in blocking of the femoral artery,

it must be emphasized that the warming of the limb either with artificial heat or with bedclothes is the worst thing that can be done. Each hour that passes increases two dangers: (1) intravascular clotting due to damage of the endothelium by asphyxia; (2) systemic shock and intoxication if the circulation is restored. Therefore embolectomy, for example, is generally unsuccessful after longer than four or five hours, and this time is shortened by heat. On the other hand, as an inadequate collateral circulation probably does more harm than good, the best immediate treatment will be the application of a narrow tourniquet (such as a rubber tube) above the point of obstruction, and the immediate thorough chilling of the limb in ice or ice-water. Pain is thus stopped and other damage minimized. The time during which the human thigh can be constricted at ice temperature without danger of subsequent shock is unknown, but it is certainly much longer than at higher temperatures. The feasible period for arterial suture or embolectomy is correspondingly lengthened and the chance of success improved, on account of the vastly better preservation of vitality in the tissues and vessels. An anesthetic will be needed if the operation is early, but not if there has been time for thorough chilling of the limb. An important advantage is that the tourniquet and refrigeration can be applied, if necessary at home or by an attendant, thus forestalling the damage that usually occurs before the operation can be begun.

CONCLUSIONS

1. The survival limit of the leg tissues of several mammalian species, deprived of circulation at room temperature, is above fifteen hours.

2. As the temperature is progressively raised the effects of asphyxia are accelerated as regards production of both local gangrene and systemic shock.

3. With reduction of temperature, these effects are retarded. Near 0°C., recovery is possible after ligation for fifty-four hours, and under better conditions this time could perhaps be considerably extended.

4. According to the experimental evidence, the method of ligation and refrigeration may find some valuable applications in surgery of the limbs, especially under certain emergency conditions.

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MOBILIZATION AND IMMOBILIZATION*

AS APPLIED TO THE ANGLE PLATE IN THE TREATMENT OF FRACTURES

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THE writer recalls the interest aroused by Lucas-Championierre forty years ago when he advocated so forcefully mobilization in the treatment of fractures. In support of his ideas he pointed out the fact that fractures of the ribs healed with motion, at most restricted, but uninterrupted. Many unrecognized fractures recovered without effort to protect the injured part from motion, particularly before the introduction of the penetrating Roentgen ray. There followed much discussion between those who were inclined to favor mobilization and those who remained arch-advocates of immobilization.

Mobilization can hardly be called a method of treatment. The fact that fracture healing takes place in the presence of motion, shows what a good job nature can do in spite of motion, what a high-geared creature man is as a self-repairing machine, and that "fractures unite with treatment, without treatment and in spite of treatment." It is really surprising that delay of union, or failure of union, is not more common. Mobilization, per se, may reasonably well be dismissed as a method or principle of treatment.

IMMOBILIZATION

Emphasis has been put on the principles of fracture treatment, and justly so. "Principles never change" is an expression oft repeated. And immobilization has stood the test of time.

By immobilization we mean immobilization of the fracture, not immobilization of the limb, of which the bone is only a part. A whole limb is immobilized for the purpose of securing immobility of the broken bone at the site of fracture. It is easy to fall into the habit of thinking in terms of the limb, because much or all of a limb is immobilized in order to immobilize a fracture, and then imperfectly.

By mobilization is not meant mobility of the fracture, which Lucas-Championerre believed beneficial rather than otherwise, but mobility of the muscles and joints without movement or displacement of the fracture surfaces. This usually means waiting until healing has advanced to the point where it is safe to remove cast or splint and when the muscles have already lost much of their elasticity and weakly contract in response to nerve impulses, no matter how strong the mental effort.

Up to the present, observations on fracture repair have been made with the limb encased in plaster and with imperfect immobilization of the broken fragments. Motion between fracture ends takes place within casts. Muscle pull is sufficient to alter position of fragments and sometimes causes flat plates of the Lane type to bend or break.

Such is fracture healing with the limb in a state of physiologic rest. The picture is a familiar one: also the appearance of the limb after healing is complete. From this picture the pattern and the time of healing has been formulated. The duration of immobilization and the time required for fracture consolidation, for recovery of use of muscles and joints after consolidation, and the pattern runs true to form.

When much or all of a limb is immobilized for several weeks, repair of a fracture takes place with all the tissues in the retrogressive process of atrophy. The muscles shrink and lose, not only their contractile power, but their elastic prop-

* HAWLEY, GEORGE W. and PADULA, RALPH D. A Bone Plate Which Will Not Bend or Break. *J. Bone and Joint Surg.* XX, 469, April, 1938.

erty. Joints stiffen, and the influx of arterial blood is lowered. There is lymphatic stasis.

The pity of it is, we know so little about the process of fracture repair. In conversation with the writer during a visit to his hospital in Compiegne during the war, Carrel expressed the belief that when the process of fracture repair was better understood, fractures would unite in much less time than they do now. The thought was suggested that it might not be so much the need of methods or agents to stimulate fracture repair, as removing inhibiting factors which retard repair and the release of forces now held in check. At the time, Carrel's hospital was largely filled with war fractures.

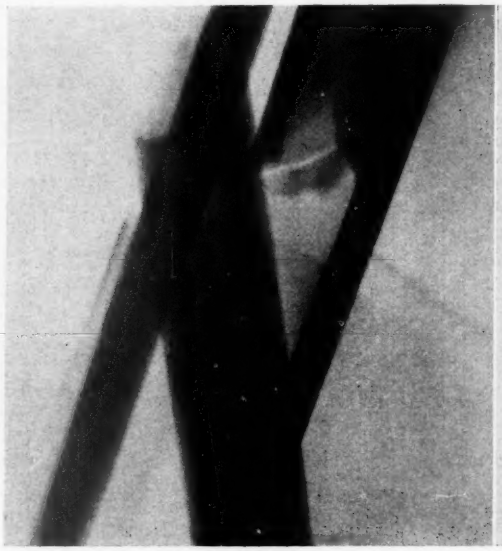

FIG. 1.

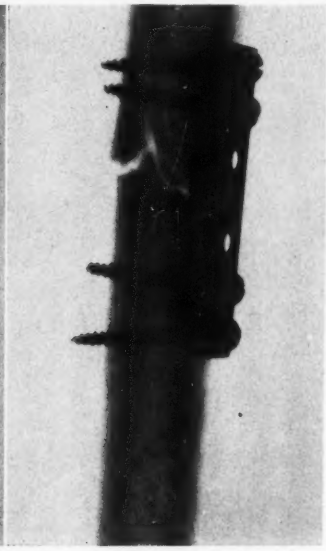

FIG. 2.

FIG. 1. *X*-ray before operation. Arm in Thomas arm splint. Reduction difficult to secure and retain.

FIG. 2. After operation. There is separation of the fragments which can be overcome by forcing fracture ends together before the last screws are introduced. Despite separation, repair was prompt. Four screws have been found sufficient in fractures of humerus, radius and ulna. In femur and tibia fractures six screws are used.

It is obvious that if a fracture can be effectively immobilized internally, there is little or no occasion for external immobilization. The principle does not change. The method is changed. And the physiologic conditions under which fracture repair takes place are changed. Healing takes place in the presence of active motion, if limited. Physiologic function is little interrupted, only reduced in degree. Muscles retain both their contractile and elastic properties. Joints continue mobile, and the arterial, venous and lymphatic flow approaches normal. Muscle action acts to pump in fresh blood and increase the influx of calcium.

Under such conditions there exist immobility of the fracture and, at the same time, mobility of the limb, with fracture repair taking place in the presence of active motion of muscles and joints, accustomed to daily exercise and activity, instead of in a state of immobility and inactivity.

A CASE ILLUSTRATING IMMOBILIZATION OF THE FRACTURE AND MOBILIZATION OF THE LIMB[1]

P. B., age 30, fractured the right humerus, September 21, 1938. Difficulty was experienced

[1] By courtesy of Dr. D. C. Patterson, Bridgeport, Connecticut. Poor health makes it necessary for the writer to depend on friends and others to put this plate into use. Dr. Patterson kindly asked me to see the operation and direct the after care.

in obtaining closed reduction, and at operation on September 28 the fragments were aligned. One fragment was lifted and a slot cut with a small Albee saw blade and widened by running the saw back and forth. One-half of the angle plate was secured to one fragment. A slot was then cut in the opposite fragment and the plate fitted into place.[1] Drill holes were made with a 5/64 inch drill point through both cortices. The holes in the proximal cortex were enlarged with a carpenter's awl. Screws somewhat longer than the diameter of the bone were then introduced. They fitted tightly and a manual test showed strong immobilization of the fracture. After the wound closed, light temporary coaptation splints were applied from the axilla to the elbow.

Elapsed time of operation was one hour and five minutes. Complete rest was advised for eight days in order to limit the inflow of blood and favor the exit of exudate from the region of fracture. The accompanying pictures tell the rest of the story.

In this case[2] the internal immobilization was all that could be desired. The screws held. None became loose. The patient experienced no pain or sensation at the site of fracture. He had, and showed, confidence in the strength of the plated humerus. New bone appeared early in the roentgenographs and progressively increased.

The "principle" of immobilization calls for effective replacement and immobilization of the fracture. The more nearly perfect the immobilization, the closer we come to fulfilling the principle of immobilization. There may be more significance than we imagine in the difference between perfect and imperfect immobilization. *It is possible that the more "specific" the immobilization, the more active and positive the process of fracture repair.*

[1] The slot acts to hold the plate and the plate to hold the fracture. Thus there is little chance for the plate to move or the fracture to slip when the screws are applied.

[2] We now have several similar cases and all follow the same pattern. The internal immobilization has been excellent and sufficient, and the screws have not appeared to become loose or change position. Each has been characterized by early and abundant new bone. One patient, an Italian with powerful muscles, had radius and ulna plated and returned to work as a stone mason in five weeks. Later these cases will be grouped and reported.

The practice of nailing and pinning fractures of the neck of the femur has lessened the need and degree of external immobilization. Effective internal immobilization has resulted in more freedom, mobility and use of the leg, more frequent consolidation and more rapid recalcification. This in feeble, elderly women and in soft spongy bone supposedly not well supplied with arterial blood.

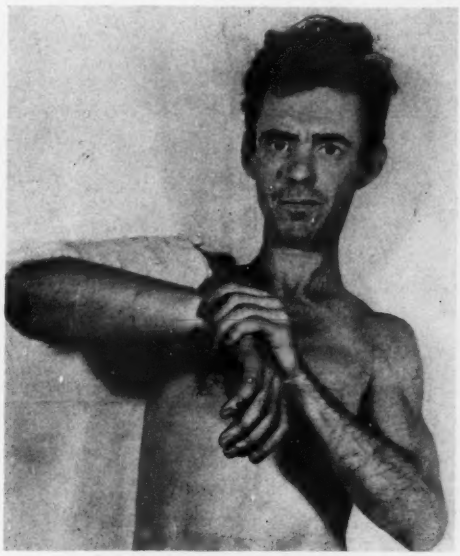

Fig. 3. Eight days after operation. Patient making first efforts to exercise muscles and joints. Light calisthenic exercise only. No passive or forced motion. Only active and voluntary. Opposite arm used to assist and carry weight of gravity of injured arm. Light surface message to promote lymphatic and venous flow.

It is conceivable that under the influence of physiological activity the capacity of the process of repair to take up calcium from the circulating blood is increased, and that calcium is transformed into callus with the calcium crystals more definitely arranged according to the physical laws of stress and strain, than when physiologic activity is absent.

The callus observed after long immobilization in plaster is soft and without form. Hey-Groves has described such early callus as mushroom in character. And Delagenierre makes much of the fact that it lacks tensile strength, like fresh cement. The mineral elements in such callus do

not take on definite crystalline arrangement or design until subjected to function and use, until Wolff's law comes into play.

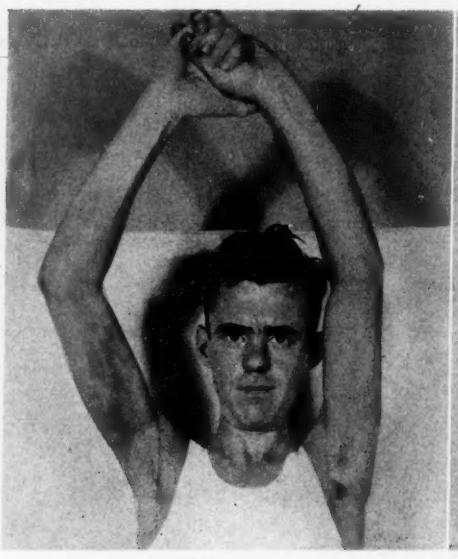

FIG. 4.

FIG. 5.

FIG. 4. Two weeks after operation. Splints temporarily removed. Patient's confidence and absence of muscle inhibition used as a guide. Exercise focused on shoulder abduction, humerus rotation and elbow flexion. Arm carried in sling.

FIG. 5. Two weeks after operation. New bone shown forming around fracture.

In response to use and function, the internal structure of such callus increases in hardness, shrinks in size, and lines of graining appear.

Wolff's law is based on use and physiologic demand. It ceases to function during physiologic rest and disuse, as evidenced by the regressive changes in bone structure, reduced density and diminished mineral content, during long immobilization.

In the process of fracture repair, soluble calcium is transformed into solid crystalline calcium. This is a physical phenomenon. The process of crystallization is favored when undisturbed by motion. Agitation interferes with and slows crystallization, and changes it into an amorphous mass, like sandstone in contrast to granite.

In the earlier group of cases in which the angle plate was used, the limb was encased in plaster, much the same as after applying a flat plate of the Lane type, though the plaster was not carried quite as much above or below the site of fracture. We had confidence the plate would not bend or break, but were not confident about the screws holding. In none did the screws appear to become loose. This gave us confidence to omit external immobilization and watch for clinical evidence of false motion and weakening of the internal fixation, study roentgenographs for change in position of plates, screws or fracture, and take note of the deposit of new bone.

It is obvious that no matter how strong a plate, its power to hold a fracture depends on how firmly the screws hold it to the bone. If the internal fixation is to be strong, the screws must *obtain and retain* a firm hold, and if the screws fit poorly or engage only the proximal cortex, the immobilization will be weak. For this reason considerable pains were taken and numerous tests made to find the type of screw and the method of its application to secure the firmest hold. To date, it has been found that long protruding screws with deep wide threads obtain the firmest hold, that the hold is greatest in the distal cortex with the butt of the screw loose in the proximal cortex. Thus far no harm has been ob-

served from protruding screw ends which appear to be soon covered with scar tissue or callus.

Fig. 6. Four weeks after operation. Effort made to arouse patient's interest in progress and recovery. Frequent short exercise preferred. Noticeable increase in confidence. Splints removed at end of third week, when fracture firm clinically and roentgenographically, plate and screws unchanged and imbedded in callus.

Various causes have been advanced to explain why screws become loose. It is possible that in some cases screws become loosened by force, by involuntary muscle jerks within a plaster cast, and once loose they easily pull out, especially in the early stages. The better anchored the screws, the less likely for this to happen. Sir Robert Jones observed that the more effective the artificial splinting, the less the tendency for muscle splinting and muscle spasm, that this was a guide to, and proof of, the excellence of the surgical immobilization.

The writer has removed many screws in the past which were just as tight when removed as when put in. In more than 150 fractures of the patella wired with stove wire, the writer has not observed pressure atrophy in the drill holes, and pressure on the bone by the wire from direct pull of powerful muscles like the quadriceps, much exceeds the pressure exerted by screws when plates are applied to the long bones.

It seems reasonable to ascribe erosion around screws to something other than pressure. It is true that pressure causes atrophy of bone. Atrophy of the vertebrae occurs from pressure of aneurysms and soft tissue tumors. But the process is slow. And screw pressure ceases with union.

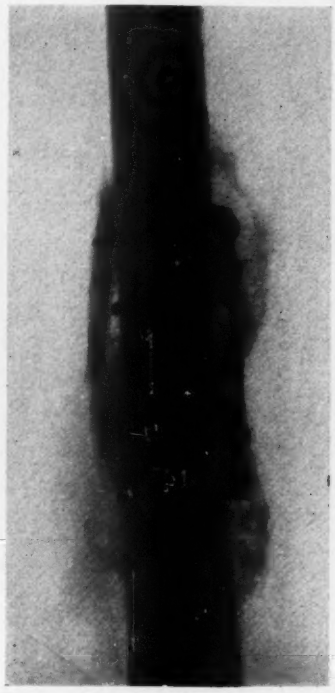

Fig. 7. Four weeks after operation. Deposits of new bone increasing. Protruding ends of screws have proved harmless and are soon covered with scar tissue or callus. Many war veterans are carrying sharp-pointed and sharp-edged pieces of metal buried in the tissues, without apparent discomfort or harm.

Erosion of bone around buried metal plates and screws has been attributed to electrolysis, and physiologic chemists have been put to it to explain electrolysis as a cause of erosion of bone, in the absence of atrophy around plates and screws. Sherman, who has plated more than 4,000 fractures over a period of twenty-five years, has observed no harmful effects, early or late, from buried plates, and it is his practice to leave the plates in.

It is not stretching the imagination to conceive that organisms may account for bone erosion around screws. It is doubtful if any open operation is free from inoculation, in spite of the aseptic ritual observed at the operating table. It is a matter of the degree of inoculation, the number, kind, and potency of the organisms introduced, and how many survive. Also, the blood stream is not free of floating organisms. Though rare, hematogenous infections of closed fractures do occur, but they are usually of low virulence. It is not unreasonable to conceive that organisms, gaining entrance, may attack the traumatized bone, particularly the exposed cortex in drill holes, causing necrosis. Bone is mineral-bearing, mesoblastic tissue, and, according to Kahn, ranks lowest in resistance to infection. It is thus most vulnerable to organisms of low virulence and not great in number. It is possible that there are different degrees of infection after plating operations, varying from undeniable suppuration, with "laudable" pus, to a wound with an innocuous sinus which leaks for a short time, to simple isolated necrosis of bone around screws and plates. Old healed compound war fractures, if opened, are commonly found to contain locked-in organisms which, mostly anaerobic and virulent, are subject to culture. The vulnerability of bone is evidenced clinically by the severity of acute osteomyelitis and the chronicity of old infections.

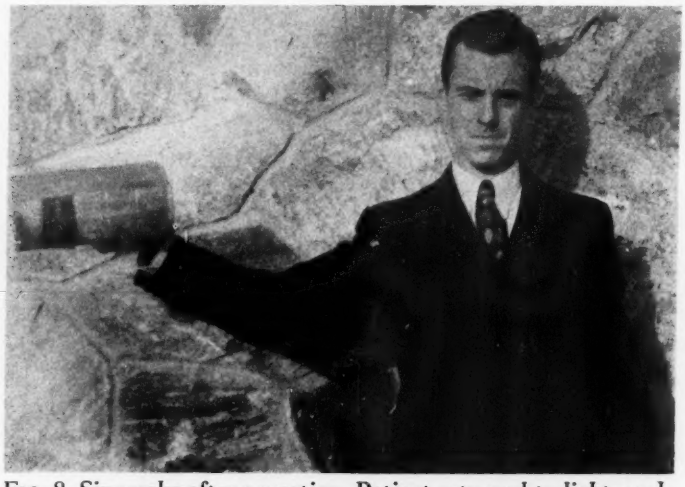

FIG. 8. Six weeks after operation. Patient returned to light work at end of fifth week. At no time was there pain or sensation at site of fracture after wound healed. Patient had confidence in strength of plated humerus from the beginning. More importance is attached at first to preserving muscle elasticity than developing muscle power, which comes later of itself.

FIG. 9. Six weeks after operation. New bone bridging line of fracture and cuff of new bone around shaft.

CONCLUSION

The writer recalls the enthusiasm for plating fractures which followed Lane's visit to this country nearly thirty years ago. This enthusiasm changed to quite the opposite a few years later, due mainly to the prevalence of infection following open operations on fractures. Many had neglected to heed Lane's counsel and admonitions. Today bone and fracture operations are better understood and practiced.

To any one using this plate, the technique described will prove helpful. It is obvious that if the internal immobilization is to be strong, the screws must hold the plate firmly to the bone and the surgeon should take as much pains as a cabinetmaker in introducing the screws.

Removable splints which do not interfere with joint motion are used to protect the fracture during the early period of repair and are removed when clinically the immobilization appears firm and the roentgenogram show increasing deposit of new bone and the screws in place.

Should the roentgenograms reveal loose or displaced screws, or should false motion appear at the point of fracture, the natural thing would be to immobilize the limb in plaster or apply a suitable splint.

There is no reason not to expect satisfactory internal immobilization if screws get and retain a firm hold. Our experience to date is that the screws have held, none has become loose or moved, and fracture repair has begun early and progressed to early consolidation.

It is reasonable to expect that the most favorable results will be obtained when operation is performed early while the muscles are still tractable and the fracture surfaces come together accurately, when the time of operation is short, and when care is used to limit tissue handling and wound innoculation.

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PRESENT STATUS OF CHEMOTHERAPY FOR INFECTIONS OF THE URINARY TRACT*

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IN considering the recent developments in chemotherapy for infections of the urinary tract I will confine myself largely to a discussion of the two compounds which have been developed recently and which are most widely used for this purpose, namely, mandelic acid and sulfanilamide. These compounds have largely displaced a host of other so-called urinary antiseptics which have been variously employed in the past decade. Medical literature of a year or two ago contained many articles concerning the therapeutic merits of mandelic acid and indications for its use. During the past year there has scarcely been a medical journal that has not contained an article concerning the action and the use of sulfanilamide. In fact, so much has been written regarding these drugs that anyone who is at all conversant with current literature has in his possession most of the investigative and clinical data concerning them.

A general survey of the literature regarding these two drugs impresses one with the fact that two entirely different principles of antisepsis are involved. Mandelic acid is an outgrowth of the use of acidification of the urine as a bactericidal agent. In fact, there are those who maintain that the greatest antiseptic action of mandelic acid lies in its ability to acidify the urine and that the specific antiseptic qualities of the drug itself are of less importance. We know that mandelic acid is not of value unless the acidity of the urine is such that the *pH* is 5.5 or less, and preferably 5.0. The action of sulfanilamide, on the other hand, rests on an entirely different basis. It certainly has no relation to acidification of the urine; in fact the contrary is true. The exact method by which compounds of sulfanilamide exert their influence has not been proved. This much is true: the action of the drug in the urinary tract differs from that in the other tissues of the body. Its concentration in the tissues and in the body fluids is much less than that in the urine and if the concentration of the drug were the same in the urine as it is in the tissues it would be inadequate for the elimination of bacteria in the urinary tract.

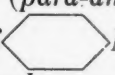
Judging from the recent observations of Osborne and others, it is apparent that sulfanilamide does not have direct antiseptic action in the body fluids, but seems to have a toxic effect on bacterial growth and is indirectly bacteriostatic. Osterberg and Helmholz have shown that sulfanilamide is eliminated in the urinary tract in such concentration that it is bactericidal. The concentration of free sulfanilamide in the urine is 60 to 125 mg. per 100 c.c. of urine and that of conjugated sulfanilamide, 50 to 100 mg. per 100 c.c. of urine, provided that a dosage of 45 to 60 mg. of sulfanilamide is administered daily. Its concentration in the blood when given in such a dosage is usually 6 to 9 mg. per 100 c.c. of blood. Both the free and conjugated forms seem to be equally bactericidal. The bactericidal value of the drug seems to be enhanced in the presence of an alkaline urine.

ORIGIN AND DEVELOPMENT OF MANDELIC ACID AND SULFANILAMIDE

Before going any further into the merits of these two drugs, let us first review their origin and development, which reads like an international romance.

* Read before the Genitourinary Section of the New York Academy of Medicine, February 16, 1938.

Mandelic Acid. A brief review of the discoveries leading to the development of mandelic acid is as follows: (1) the discovery by German chemists that certain media when acidified were bactericidal to the colon bacillus; (2) the discovery by Shohl and Janney that the growth of the colon bacillus in urine could be inhibited when the urine was acidified by means of drugs given orally; (3) the discovery by Nielson that exclusion of carbohydrates from the diet caused the urine to become acidified and bactericidal; (4) the independent discovery and application of this principle by Clark and Helmholz who used a ketogenic diet with additional acidification and thereby successfully eliminated urinary infection; (5) the discovery by Fuller that beta-oxybutyric acid is the acid radical present in ketonurine and that it has bactericidal properties; and (6) the discovery by Rosenheim that mandelic acid, an exogenous acid which has a chemical composition similar to beta-oxybutyric acid is excreted intact by the kidney, and has bactericidal properties when administered in the treatment of urinary infection.

Sulfanilamide (para-amino-benzene-sulfonamide; ). Even more interesting in development has been the elaboration of prontosil and sulfanilamide; its study would repay anyone who is interested in the details of its chemical development. It will be necessary for me to confine myself to a synopsis of the more important stages of its development, which have been described by Schulte:

1. The drug was first mentioned by Gelmo in 1908, while working on the chemistry of azo dyes for the German dye industry.

2. In 1913, Eisenberg discovered bactericidal powers in certain azo dyes in vitro and conceived the possibility of employing chrysoidine in therapeutics.

3. In 1917, Jacobs and Heidelberger, working at the Rockefeller Foundation, synthesized meta-amino-benzene-sulfonamide and other related products. They stated that these substances were highly bactericidal in vitro and planned to investigate this further but, unfortunately for American medicine, this never was done.

4. In 1926, Ostromyslensky introduced pyridium into American therapeutics (mallophene-serenium).

5. In 1932, Mietzsch and Klarer synthesized prontosil, prontosil rubrum, prontosil flavum, and prontosil tablets, or sulfonamido-chrysoidine, which was, however, very insoluble in water.

6. In the same year, Domagk, working with these chemists, discovered the efficacy of this and other closely related azo dyes in streptococcic septicemia of mice. One of these compounds was patented under the names of streptozon, streptozon S, prontosil 2, prontosil red, prontosil S, prontosil soluble, prontosil solution, or D-5214.

7. In 1913, Domagk and others reported its use in the treatment of streptococcic infection.

8. The Trefouëls, Nitti, and Bovet, working in Fournot's laboratory at the Pasteur Institute, recalled the hypothesis advanced by Heidelberger and Jacobs that sulfonamido-chrysoidine, when broken down, formed para-amino-benzene-sulfonamido, which we call "sulfanilamide." They assumed that this was the effective portion of the prontosil molecule and they were the first to show its bactericidal power.

9. English chemists, Fuller, Colebrook, Buttle and O'Meara, showed that prontosil could be reduced to sulfanilamide.

10. It was in the English laboratories that Long and Bliss were informed of these new chemotherapeutic agents and they took these ideas back to America. They proved that sulfanilamide is formed in vitro by reduction and they found that cysteine was an ideal reducing agent for their experiments. They found that sulfanilamide was bacteriostatic in vitro, whereas prontosil and cysteine were not.

11. Marshall, Cutting and Emerson found that part of the sulfanilamide ingested is excreted in the urine without

chemical change. A small part is converted to para-acetyl-amino-sulfonamide.

12. Rosenthal synthesized di-sulfanilamide but its disadvantage was that it was only very slightly soluble in water.

TREATMENT

In a consideration of the respective therapeutic merits of these two drugs, we find that both have their places in the treatment of urinary infection. The choice depends largely on such indications as idiosyncrasy, type of bacteria present, the patient's general condition, the age of the patient and coincident complications. As a general rule, it may be said that therapy with mandelic acid causes less reaction and is usually not so toxic as sulfanilamide. On the other hand, among the advantages of sulfanilamide may be included a more rapid and spectacular elimination of bacteria, a wider range of types of bacteria affected, and an independence from the limitations of the process of acidification.

There is considerable difference of opinion as to the desirability of the two drugs. Some urologists, particularly if they have treated a series of patients who had severe reactions following the use of sulfanilamide, use mandelic acid in most cases of bacilluria, employing sulfanilamide only when the administration of mandelic acid fails to have the desired effect. Bacilluria in the female urinary tract usually can be controlled easily by the administration of mandelic acid and with a minimum of reaction. On the other hand, there are those who are impressed by the ease with which bacteria frequently are eliminated by the administration of sulfanilamide and they use this drug routinely. In men, because the infection usually has its origin in the prostate gland and seminal vesicles, it is generally advisable to use sulfanilamide on account of its bacteriostatic action in these foci. There are definite indications for the use of both drugs and they should be used interchangeably.

The administration of mandelic acid is likely to cause acidosis among old adults. Acidosis is also associated with the administration of sulfanilamide, although less frequently. We usually give mandelic acid in an effervescent form of a flavored elixir of ammonium mandelate (20 per cent), which is usually better borne than the more concentrated solutions. In a few cases, a 10 per cent aqueous solution of the ammonium salt is best taken. More recently the use of a calcium preparation in tablet form, in the hands of some, has been associated with less reaction than the liquid form. If one type of solution is not tolerated well, it is advisable to try another. Although the majority of patients do not have a strong dislike for the various forms of mandelic acid, some will have a violent distaste for it in any of its different pharmaceutical forms. If such occurs, it will be necessary to use sulfanilamide in the place of mandelic acid. Occasionally, placing the intolerant patient at rest in bed seems to lessen such reactions.

Although Helmholz and Osterberg have shown that the administration of mandelic acid to dogs is followed by an increase in the concentration of blood urea, this is seldom observed among human beings, provided that renal function is normal. When renal function is impaired, the administration of either drug may further reduce renal activity and cause various symptoms of toxemia. Although in most cases either drug will cause toxic reactions to a varying degree, as a rule sulfanilamide is the better borne of the two, because acidosis frequently follows the administration of mandelic acid. In many cases of renal dysfunction neither of the drugs is eliminated in sufficient concentration in the urinary tract to be of much value. In cases in which the reduction in function is the result of long-standing urinary obstruction sulfanilamide is better tolerated than mandelic acid and is more efficacious in the treatment of such a condition than it is in cases of glomerular disease. The administration of these drugs is often followed by a great decrease in renal function, as is shown

by a rapid increase in the concentration of blood urea.

There is some difference of opinion as to the efficacy of sulfanilamide as a preoperative and postoperative aid. It has been our experience that in the presence of severe infection in the urinary tract sulfanilamide can sometimes be employed to advantage in diminishing the degree of infection prior to operation. As a postoperative aid, however, it has not proved to be of much value in our hands. Thompson employed it after prostatic resection in a series of cases in which a variable degree of postoperative urinary infection was present. He failed to see that it made any difference in the degree or duration of the postoperative infection and he has discontinued its use. It would seem that in common with all forms of chemotherapy, this drug is not efficacious in the presence of tissue which has recently been operated on. It may be of value, however, in the treatment of infection that persists some three or four weeks after operation when the tissues have healed.

The drug proved to be of comparatively little value in the presence of stone, tumor, or lack of drainage in any portion of the urinary tract. It is seldom that much benefit results from chemotherapy in the presence of drainage tubes in either the upper or lower portion of the urinary tract.

DOSAGE

The dosage of mandelic acid is more uniform than that of sulfanilamide. It is usually necessary to use 10 to 12 Gm. daily to secure results. The dosage of sulfanilamide, however, varies widely with the age and general condition of the patient and with the type of infection. The administration of an initial large dosage is not so essential in the treatment of infection in the urinary tract as it is in the treatment of a fulminating type of general infection and there is a tendency toward administering a lower dosage than was at first thought necessary. The dosage which is tolerated by the young adult is decidedly different from that tolerated by the older adult. The majority of young adults experience comparatively little reaction from an initial dosage of 60 to 80 gr. (4 to 5.2 Gm.) and after a few days it can usually be reduced to half that dosage. Among adults aged 40 years or older, and among many younger women, a more cautious approach is desirable. Severe reactions with collapse are not infrequent among patients more than 60 years of age. Idiosyncrasy on the part of the patient appears when least expected and must always be anticipated.

Problems associated with the use of sulfanilamide in the treatment of widespread infection in the tissues are entirely different from those encountered in the treatment of infection confined to the urinary tract. Although the concentration of sulfanilamide in the tissues sufficient for bacteriostatic action is much less than that required for a like purpose in the urinary tract, the administration of a very heavy dosage is frequently necessary in order to have any effect on systemic infection. Cases are sometimes encountered in which it is necessary to give as much as 120 gr. (8 Gm.) daily, and if improvement is not noted, it has been advisable to give in addition, subcutaneous injections of prontosil. Prontosil apparently, in some of these cases, not only acts differently from sulfanilamide, but also seems to add to the efficacy of sulfanilamide.

EFFECT ON RENAL INFECTIONS

Failure in eliminating renal infection may be owing to widespread cicatricial changes in the renal tissue and retarded renal drainage resulting from chronic infection. Nevertheless, I have recently observed several cases of chronic pyelonephritis of this type in which the condition improved after the administration of repeated courses of sulfanilamide. I recall one case of cicatricial chronic pyelonephritis in particular, which had existed for twelve years, with frequent periods of

hematuria, and which failed to respond to any form of treatment, local or general. The infected urine gradually cleared and finally, after repeated courses of sulfanilamide, became crystal clear and sterile on culture. If the course of treatment is repeated at short intervals in some cases, the infection is removed. This procedure should be tried in stubborn cases. Sometimes, disappearance of the bacteria does not occur until one or two weeks after administration of the drug has been discontinued.

A working knowledge of bacteriology is necessary for the intelligent use of chemotherapy. The administration of mandelic acid will usually control the ordinary forms of bacillary infection. When persistent types of bacilli are present and those which have urea-splitting properties, such as proteus, sulfanilamide is to be preferred. Although mandelic acid has but little effect on the various coccal infections among adults, it has a specific action on Streptococcus faecalis, against which sulfanilamide has little or no inhibiting effect.

Sulfanilamide is usually of greater value when bacteria are found in a persistently alkaline urine.

We still must frequently fall back on the use of arsenical preparations, such as neoarsphenamine. This is particularly true with regard to coccal infections of long standing, and in cases in which cocci occur in a urine which has a low hydrogen ion concentration. It has been our experience, however, that neoarsphenamine is only efficacious in eliminating coccal infection in approximately 50 per cent of uncomplicated cases. By uncomplicated cases I mean those in which complications such as stone, obstructed urinary drainage, or chronic cicatricial changes in the renal tissue are not present. Because the presence of stones in the kidney is so often accompanied by coccal infection, the elimination of such infection is often a baffling problem. It is evident that the ideal disinfectant for coccal infection still remains to be discovered.

COMPLICATIONS

A special problem presents itself when several types of bacteria are present in the infected urine. In a recent review of 200 cases of chronic pyelonephritis, I found that mixed infection was present in more than 10 per cent of cases. I believe this percentage is greater when the subacute type of infection exists. The combination which is probably most frequently observed is that of the colon bacillus with Streptococcus faecalis. The coincidence of the colon bacillus and Aerobacter aerogenes, and the colon bacillus with various types of cocci occurs often. In fact, all sorts of combinations of bacteria have been encountered. If a course of mandelic acid is given and if the urine fails to become clear, coccal infection frequently will be found to persist. If this infection does not disappear with the use of sulfanilamide, neoarsphenamine should be administered. If, after employing sulfanilamide as a primary therapeutic agent, bacilli are eliminated and Streptococcus faecalis persists in the urine, the organism will usually be eliminated subsequently by the giving of a few doses of mandelic acid together with supplementary acidification of the urine.

When infection persists in spite of all the various forms of therapy, it must be inferred that there is some cause for the persistence of the infection. That cause must first be eradicated. In order to ascertain the results obtained with chemotherapy, the cases should therefore be divided into groups, one group consisting of complicated cases and the other of uncomplicated cases.

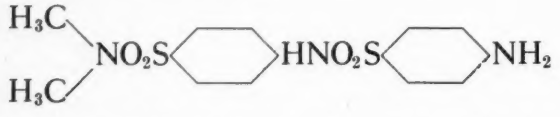
The most frequent complication which hinders elimination of bacteria among men is prostatic infection. Bacteria are often eliminated from the bladder, only to return from a persistent prostatic infection. It is, of course, necessary that vigorous treatment should be directed to this region. As has been emphasized previously, prostatic infection may be secondary to other foci of infection and such primary foci should

first be eliminated. Particularly is this true of tonsillar infection. Sulfanilamide has been found to be very helpful in the treatment of chronic prostatitis and its administration should be repeated at intermittent periods. Prostatic massage should be employed at the same time and experience has shown that administration of sulfanilamide facilitates the results of massage to a great extent. It has been our experience that reduction in the degree of prostatitis can be brought about in at least two-thirds of the cases. A great reduction in the time required by massage for the elimination of infection is observed. Incidentally, relief of associated nonspecific discharge also occurs. Sulfanilamide is probably excreted in the prostatic secretion in insufficient concentration to be bactericidal. The exact manner by which the prostatic infection is influenced is not known, but apparently, sulfanilamide exerts the same toxic influence on bacteria in the prostatic tissues that it does on bacteria in other tissues of the body.

It is of interest to review some of the complications which are sometimes observed following the use of sulfanilamide: (1) Nausea occurs to a slight degree in most cases but is usually overcome by reducing the dose for a day or two. (2) Headache and dizziness, although frequently present, are not usually severe enough to incapacitate the patient. Such symptoms can usually be overcome by a temporary reduction of dosage or by cessation of administration of the drug. Either of these complications may occur on the first trial of the drug but disappear subsequently. (3) Skin eruptions such as urticaria or a "contact" eruption may be limited to the surfaces of the skin exposed to sunlight or may involve the skin of the entire body. Such eruptions always disappear promptly after the administration of the drug is discontinued. (4) Cyanosis may occur and may be due to hemoglobinemia, sulphemoglobinemia, or methemoglobinemia. It disappears on discontinuing administration of the drug and is of no great clinical significance. (5) Fever of variable degree may occur either early or late in the course of administration of the drug. In some cases, it has been observed within twelve hours after the administration was begun. Although usually ceasing within a day or two after administration of the drug is discontinued, it may persist longer. (6) Acidosis may occur as previously mentioned, and is a signal for immediate discontinuance of use of the drug. The symptoms may continue several days afterward. (7) Leucopenia, usually controlled by transfusions of blood, may persist in spite of various methods of treatment employed. The chemical formulas of the sulfonamide group of drugs are based on the benzene ring. It should be remembered that benzol, which belongs to this group, has been employed to reduce the formation of leucocytes in cases of leucemia. This same action may explain the appearance of leucopenia and agranulocytosis following the use of sulfanilamide, as this drug also is a compound containing the benzene ring. The advisability of using a substance which is definitely toxic may be questioned. It must be remembered, however, that according to the science of pharmacology small doses may be of great therapeutic value, whereas large doses may act as poisons. It has been shown experimentally that a low concentration of sulfanilamide in the blood and tissues usually does not affect the production of leucocytes, although when the drug is used in too large or too long continued doses the number of leucocytes may be diminished. It seems that there are certain patients who have an allergic reaction to the drug the nature of which seems to be a mechanism of profound interference with the production of leucocytes. (8) Only occasional cases in which death has occurred have been reported and the cause in some cases has not been known. In one of our cases, death followed the performance of transurethral resection for carcinoma of the prostate gland. Sulfanilamide was administered for a week without any untoward

result; then fever suddenly developed and the patient died a week later; a fever persisted until death. At necropsy a definite cause of death could not be determined.

Although sulfanilamide represents a tremendous advance in elimination of infection, nevertheless the ideal bactericide has not yet been found. The toxic manifestations of this drug are a serious handicap to its employment in many cases. A compound, distinctly less toxic and supposed to replace sulfanilamide, was discovered recently by Domagk and his co-workers. Its formula is as follows:



Grütz found this to be very effective against staphylococci, colon bacilli, anaerobic gas bacilli and the gonococci. Chemically it is di-methyl-di-sulfanilamide. It was referred to tentatively as D-373 and was also known as uliren. In this country it was called diseptal. It was found that this drug was distinctly less toxic than sulfanilamide, and many patients who had a severe reaction following the use of sulfamilamide had few, if any, symptoms as the result of its administration. This drug also was supposed to be somewhat more bacteriostatic than sulfanilamide. Owing to the diminished toxic reaction di-methyl-di-sulfanilamide could be employed longer and in larger doses than sulfanilamide.

This drug was employed at The Mayo Clinic in a considerable number of cases with excellent results. Everything went well until two patients to whom it was given over a period of two or three weeks suddenly experienced wrist-drop and manifested other evidence of toxic neuritis. Other observers in this country have had similar experiences, although in Germany such complications have not been reported. It was found that such reactions took place only in cases in which large doses were continued over a period of several weeks. It has been the experience of others, however, that this compound can cause serious nerve injury. The drug was taken off the market at once by the manufacturers and efforts are being made to eliminate its toxic qualities.

Similar compounds which will not cause systemic toxemia and will be even more bactericidal than sulfanilamide or di-methyl-di-sulfanilamide, will undoubtedly soon be made available. The future of chemotherapy in combating infection would seem to offer great possibilities.

TRANSPLANTATION OF THE URETERS*

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INTRODUCTION

FOR years it has been a recognized fact that there were a few pathologic conditions that required for their relief the short-circuiting of the urine. Coffey was the modern pioneer in this work, and it was due to his experimental and clinical efforts that the various transplantation procedures of today were devised. That any operation of this nature has a high mortality and morbidity goes without saying and it usually is indicated only in those cases where death is preferable to the continued subjective suffering of the unfortunate individual. The procedure, then, is never one that will become common practice in the hands of any one man and as the indications are rare very few men will ever acquire sufficient experience to become real experts. However, many competent urologists will do a few of these operations in a lifetime of specialized effort. To those of us who have had even a small number of these cases, falls the often unpleasant task of reporting our experiences. If this is done frankly, only good can come from open discussion of our successes and, more particularly, our failures. This is true if we have sufficient interest to follow our failures to the autopsy table when the reason for them is often very plainly written.

The work of Coffey, the Mayos, Beer, Mathé, Kirwin, Counsellor, Hinman, and many others is now familiar. This report, therefore, will be based solely on personal experiences.

INDICATIONS FOR VARIOUS TYPES OF URETERAL TRANSPLANTATION

1. Carcinoma of the bladder.
   (*a*) Without ureteral obstruction.
   (*b*) With ureteral obstruction, unilateral or bilateral.
2. Carcinoma of the cervix (postradiation). With ureteral obstruction, unilateral or bilateral.
3. Vesicovaginal fistula.
4. Interstitial cystitis, non-tuberculous.
5. Interstitial cystitis (healed contracted tuberculous bladder).
6. Anomalies of the lower urinary tract —epispadias and extrophies where there is complete lack of urinary control.

There have been many types of transplantation procedures designed to aid these various conditions. Where the ureters, one or both, have been obstructed low in the pelvis, nephrostomy with permanent drainage has been done in a few cases. Usually this has been only a temporary procedure to save the kidney until the obstruction could be relieved. I have never been forced as yet to do a permanent nephrostomy.

Occasionally, due to stricture of a ureter either from intrinsic or extrinsic causes, it is necessary to transplant it into the bladder. This is not a particularly difficult problem and is usually successful. I have done this operation once with a good result. Occasionally, it should be good treatment to do an anastomosis between the ureter and the bladder or even between the pelvis of the kidney and the bladder. This latter procedure was done by me for the first time in April, 1928, and is the only case of its kind on record. The indication was a huge hydronephrosis of the right pelvis of a horseshoe kidney due to low obstruction of the ureter. The operation was a perfect success and the patient is still living and in good health.

* Read before the Section of Genito Urinary Surgery, New York Academy of Medicine, March 16, 1938.

Transplantation of the ureters to the surface of the body has been done frequently by Beer, Mathé, and others. The indication is usually carcinoma of the bladder. The operation is intended to short-circuit the urine away from the bladder so that this organ may be totally destroyed or removed and the carcinoma thereby cured. Openings of the ureters are then treated by placing indwelling catheters in them and the urine is carried to containers strapped to the legs. This operation, while not without risk, is an extraperitoneal procedure and relatively simple. The question of morbidity immediately arises. I have never done this operation by choice. I know that Beer and others follow this procedure, reporting quite a number of patients who are living and enjoying life.

My own experience with the operation has been limited to ten cases where the lower end of both ureters had become occluded as a result of radiation therapy directed at a cervical carcinoma. These were virtually emergency operations to relieve the obstructive hydronephrosis. Most of the patients died in a few months; two lived a year, and all died of urosepsis. I have never deliberately done the operation for carcinoma of the bladder, believing that if any transplantation procedure were done it would be better to transplant into the bowel rather than to the skin. Because of the morbidity, I cannot see the reason for transplantation to the skin for carcinoma of the bladder even though there is little mortality. If we transplant ureters into the bowel for epispadias and exstrophy, why create this condition? I am willing to admit that the operation is occasionally justified because at times life is greatly prolonged and some people will prefer a more or less miserable life to death.

This statement brings up an important problem in the handling of all of these cases. In the case of a child, the parents should be told of the high mortality and morbidity. In an adult the person upon whom any of these operations is to be performed should be taken into the physician's confidence and none of these surgical procedures should be performed unless *elected* by the patient. Many will refuse such procedures when they fully realize the situation even if they recover.

TRANSPLANTATION OF URETERS INTO THE BOWEL

The first indication for transplantation of the ureters is cancer of the bladder.

Case 1. C. J. D., male, age 61, was admitted on August 5, 1930, with a diagnosis of carcinoma of the bladder. The patient's chief complaint was blood in the urine, with occasional inability to void. He had some frequency, urgency, and nocturia. He had been perfectly well until two and a half years before, when he noticed that his urine was blood-tinged and that the condition was getting worse.

It was impossible to see the entire tumor through the cystoscope. There was a large carcinoma at the base of the bladder, involving the trigone and the bladder itself.

Laboratory Report. Red blood cells numbered 4,520,000; white blood cells 8,000; hemoglobin 70 per cent; blood urea nitrogen 12.6; blood sugar 150; Wassermann negative. Culture of the urine showed many colonies of staphylococci, no tubercle bacilli, but a large number of pus cells. The tumor tissue from the bladder showed carcinoma of the urinary bladder with evidence of rapid growth. Microscopic section showed typical carcinoma of the bladder epithelium, many hyperchromatic nuclei and large numbers of mitotic figures. The tumor was papillary in structure in some places and showed mild inflammatory reaction.

On August 6, bilateral transplantation of the ureters was carried out using the Coffey catheter technique. On August 7, the lungs were clear. The abdominal peristalsis was exaggerated. On August 8, the patient complained of pain in the abdomen. An enema was ineffectual in relieving the abdominal distention. On August 10, the patient died due to obstruction of the bowel.

Autopsy. Incision in the abdomen showed no excess of peritoneal fluid and there was no evidence of peritonitis. The muscles were deep red in color. The lower bowel from the cecum to the splenic flexure and small bowel was filled with fluid and greatly distended with

gas. There was no evidence of adhesions, except as noted later, and no evidence of loss of peritoneal or mesentery fat. The appendix was in the right position, long but normal. Dense adhesions bound the bowel for a length of about 4 inches at the splenic flexure, the adhesions contracting the descending colon to such an extent as to give complete obstruction at this point. From there on the descending colon collapsed.

The anastomosis of the two ureters was completely healed over with some few inflammatory adhesions at the site of the anastomosis, but the condition over the sigmoid at this site showed rapid healing. There was no other inflammatory evidence except that due to the trauma of operation. The ureters, where they had been severed at the bladder, were closed and there was no leakage from the bladder.

The bladder was small and empty and was removed with the prostate. The prostatic urethra and base were filled with mushroom growth, carcinoma. The bladder walls were markedly hypertrophied.

The liver was free from metastasis, and the kidneys were normal in size. There was no enlargement of any of the vertebral glands. There was no excess of pleural fluid on either side and no adhesions in either lung except for a few posteriorly to the parietal pleura on the left side. The autopsy was otherwise negative.

Microscopic sections of kidney revealed no inflammatory reaction. All sections were essentially normal renal structure and there was no inflammatory reaction in the pelvis of either kidney.

Pathologic Diagnosis. Death caused by obstruction of the bowel. No evidence of peritonitis.

Case II. W. R., male, age 64, was admitted on September 26, 1930, with a diagnosis of carcinoma of the bladder. The patient's chief complaint was blood in the urine, which he noticed on September 20. He had no other discomfort at this time. He had lost no weight.

On September 23, cystoscopy revealed a carcinomatous growth on the left lateral wall of the bladder, which was so large that it could not be entirely visualized with the cystoscope. The laboratory report stated that a section of tumor tissue showed typical carcinoma of the bladder epithelium with mitotic figures. The blood chemistry was normal; Wassermann and Kahn tests negative; blood counts were all within normal limits.

On September 28, the patient was operated upon. Both ureters were transplanted into the rectum, using the Coffey catheter method. On September 29, urine dripped freely from the catheters. On September 30, the bowels moved slightly, urine dripped freely. On September 31, the patient was unable to move the bowels, but urine dripped freely. The patient died suddenly from cardiac dilatation.

Autopsy. The left side of the chest showed a marked prominence over the cardiac area. The abdomen was moderately distended. Primary incision revealed a moderate quantity of bright yellow adipose tissue. The muscles were of good color. The coils of the small intestine were found to be greatly congested; careful observation revealed here and there a small quantity of exudate, which joined adjacent loops of the intestine together. Upon pushing the coils of the intestine aside, it was observed that there was a slight excess of peritoneal fluid, perhaps 15 or 20 c.c., markedly turbid and somewhat blood-stained. The omentum showed little exudate and the anterior surface of the stomach was only slightly congested. There appeared to be no definite exudate upon the lower surface of the diaphragm nor the external surfaces of the spleen or liver.

Ureteral catheters extended up both uretres nearly to the kidney pelvis and down through the rectum, leaving the body at the anus. No definite seep from the rectum into the peritoneum had occurred. (Fig. 5.) However, on the right side at or near the point of entrance of the ureter into the rectum there was a considerable quantity of exudate, which was more abundant in this region than elsewhere. Careful examination revealed no other source of the peritoneal exudate.

Culture of the peritoneum showed several colonies of staphylococci among which were seen small Gram-positive diplococci and small chains of three and four cocci (Gram-positive). The pericardial cavity contained about 20 c.c. of clear, straw-colored fluid. There were no pericardial adhesions and both layers of pericardium were smooth and glistening. The only pleural adhesion was a slight one between the space of the left lower lobe and the diaphragm. There was no excess of pleural fluid and both layers of pleural sacs were everywhere smooth and glistening. The pulmonary artery con-

tained fluid, fluid blood, and post-mortem clots. Smears of peritoneum showed a moderate number of polymorphonuclears, large mononuclear wandering cells, and occasional small Gram-positive diplococci. The heart was greatly enlarged, showing dilatation with hypertrophy.

Microscopic examination revealed a mild mechanical pyelitis in the right kidney due to mercurochrome, but this did not extend into the renal substance.

Pathologic Diagnosis. Ileus; mild peritonitis (this might have cleared up) and acute dilatation of the heart.

Case III. M. Z., male, age 51, was admitted to the hospital on March 14, 1931 with a diagnosis of vesical calculus. The patient's chief complaints were suprapubic pain, frequency, incontinence and hematuria, all of which had been present only three weeks. Cystoscopic examination revealed a large tumor involving most of the bladder wall; this proved to be a squamous cell carcinoma. The blood pressure was 120/80. There had been a previous lower abdominal operation.

On March 16, both ureters were transplanted. The sigmoid was found to be bound down in the right pelvis by marked adhesions, and was freed with difficulty. Both ureters were badly dilated. They were transplanted by the Coffey catheter technique. An average of 24 ounces of urine was drained every twenty-four hours. On the fifth day the catheters were removed and convalescence was deemed satisfactory. On March 29, thirteen days after operation, the patient became distended and all attempts to relieve the distention failed. Death from ileus followed on March 31, fifteen days after operation.

Autopsy. The bladder was 8 cm. in length and ureteral stumps which measured about 4 cm. were attached to it. The bladder wall was greatly thickened and its mucosa soft and necrotic in appearance. Extending over the greater portion of the bladder surface was a broad area of new growth, the surface of which was like a cauliflower in appearance, while the underlying tissue was soft and friable. This malignant condition extended up over the trigone to the urethral orifice and, except for a small area on the anterior wall, appeared to have infiltrated the entire mucosa. Sections of the wall showed the new growth to have infiltrated in some places through to the peritoneal coat. No apparent metastases outside the bladder were demonstrated. There was intense dilatation of the ileum.

The sigmoid colon extended for about 10 cm. in the right iliac fossa. The ureteral transplants were made in a diagonal direction through the intestinal wall. One of these was still intact, the other was apparently torn away by the trauma of removal. The pathway of incision through the intestinal wall and the opening through the mucosa appeared in fair condition, although infection around both of these areas was present and beginning peritonitis in the region of the sigmoid was noted. Death was due to ileus (slight beginning peritonitis).

Case IV. A. H., male, age 35, was admitted June 2, 1937 with a diagnosis of squamous cell carcinoma. He was discharged on November 6, 1937 and readmitted on November 19. On the first admission the chief complaint was frequency and burning on urination. Cystoscopic examination revealed an extensive growth of the bladder. The first pyelograms were normal and showed normal ureters. There was no evidence of metastasis. Transplantation of the ureters with total cystectomy was planned but not done. Deep *x*-ray therapy failed to give any relief and the patient died of urosepsis on January 10, 1938.

Autopsy. This was entirely negative except for the following findings:

The right kidney weighed approximately 160 Gm., and measured $11 \times 6 \times 4$ cm. The capsule was moderately adherent, the kidney pelvis much distended, containing about 30 c.c. of thick purulent-appearing fluid. In part of the kidneys, the pyramids and cortex showed much atrophy. Elsewhere the cortex was 6 to 8 mm. in thickness. No definite abscesses were noted in the kidney substance. The right ureter was much distended. It varied from about 1.5 to about 2.5 mm. in diameter and contained much thick, purulent-appearing fluid. The mucosa showed much desquamated epithelium. A probe introduced into the right ureter did not pass into the urinary bladder.

The left kidney was considerably larger than the right, weighing approximately estimated weight 175 Gm. The capsule was thin and stripped easily. The kidney pelvis was slightly distended with about 20 c.c. of thick purulent fluid.

The kidney tissue showed but little atrophy. The cortex varied from 6 to 8 mm. in thickness. In places small yellowish streaks which might

indicate diffuse suppurative nephritis, were seen parallel to the collecting tubules. No definite abscesses were seen in the kidney tissue. The left ureter, 1 to 2 cm. in diameter, was distended with purulent fluid. A probe introduced into the lower part of the ureter passed into the urinary bladder with but little resistance.

The urinary bladder was considerably enlarged, having an average diameter of about 9 cm., with walls from 6 to 10 mm. in thickness. It contained about 150 c.c. of turbid yellowish-gray fluid. In the lower half of the bladder the mucosa showed a necrotic, moth-eaten surface, with small, poorly defined elevations in some places. Apparently the whole of the lower half of the bladder was involved in an extensive malignant tumor growth, which affected the whole of the trigone and much tissue surrounding both ureters. In places the mucosa appeared as a sloughing necrotic mass. The necrosis and thickening of the mucosa extended into the membranous urethra for a distance of about 2 cm. Apparently the tumor tissue extended into the mucosa of the urethra, but the anterior and upper part of the mucosa of the bladder, while showing moderate trabeculation, swelling and edema, was apparently free from tumor growth.

Examination of the prostate gland showed no hypertrophy nor invasion by the tumor tissue. The seminal vesicles were not involved. Examination of the urethra showed no stricture or obstruction.

Microscopic. Sections of the urinary bladder showed a very widespread, far advanced, squamous cell carcinoma, tumor cells invading the bladder wall quite extensively. Numerous epithelial pearls were observed and the nuclei were large and hyperchromatic. Moderate numbers of mitotic figures were present. The tumor showed necrosis on the surface, but the deeper lying cells showed little or no necrosis. A widespread invasion of the tissue showed that the tumor was highly malignant.

Anatomic Diagnosis. Far advanced squamous cell carcinoma of the urinary bladder with extension to the mucosa of the posterior urethra and obstruction of both ureters and bilateral pyonephrosis.

This last case brings up an important point. This man had been under our observation for about six months, and ureteral implantation into the bowel with total cystectomy had been contemplated early. His original study revealed no dilatation of the ureters or pelvis. His cystoscopic study revealed such a complete involvement of the entire bladder that it seemed impossible completely to remove the disease. The operation for that reason was not done.

Autopsy revealed that death was due to urosepsis with wide dilatation of the ureters and pelvis. Strangely enough, the carcinoma (squamous cell) was completely limited to the bladder without extension or metastasis. A perfect case for transplantation and cystectomy.

All of these cases, it is noted, terminated fatally.

I am convinced from my own personal experience, small though it be, and from conversations with many men more experienced than I, that carcinoma of the urinary bladder should not be treated by ureteral transplantation and total cystectomy. However, I will not seriously criticize those who differ with me, but will present the argument from my own experiences with this entity. Three cases of transplantation are reported here—with three deaths.

In a series of fifty-seven consecutive cancers of the bladder since 1930, we have lost twenty-two patients. Several in the group of thirty-five living have had recurrences. All of these patients have been treated by the use of radium and *x*-ray, almost all of them without any other operative procedure. In those who died the only operative procedure was a suprapubic cystotomy. Of those who are living two have had cystotomies. One must note that a number of the dead succumbed to conditions other than their cancer; on the other hand, all the living may not, of course, be considered as cured.

Cancer of the bladder, to be cured, must be found early and treated promptly. Usually the curable types, early diagnosed, can be treated cystoscopically with radium and *x*-ray. If we are fortunate enough to get the cases early, before the infiltration has

involved pericystic tissue or metastasis has taken place, the vast majority can be cured. Cancer of the bladder fundus (one of its rarest locations) is as amenable to bladder resection as is cancer of the fundus of the uterus to supravaginal hysterectomy and the prognosis is usually good, particularly if followed by *x*-ray therapy. (This is denied, however, by some men.)

These early carcinomas may also be cured by transplantation of the ureters and total cystectomy. Both operations are so formidable from the mortality and morbidity aspects that they are absolutely unjustifiable when such excellent results can be obtained by radium, *x*-ray, and at the worst, simple resection or cystotomy, combined with *x*-ray and radium. There is virtually no mortality associated with these procedures, the morbidity is moderate, and very little time is lost.

This holds true whether the ureters are transplanted to the skin or to the bowel, although, of course, transplantation to the skin is obviously a more simple operation than transplantation into the bowel.

Cancer of the bladder that has progressed beyond the so-called early curable stage cannot be cured by these formidable procedures if it cannot be cured by the other agencies (radium and *x*-ray). Occasionally an apparently inoperable, incurable case of cancer will respond to these agencies, but leave the lower ureter or ureters obstructed and the bladder so contracted that the urine must be short-circuited. Then transplantation must be considered, not as a treatment of the cancer, but for the same reason that it is considered in the postoperative contracted bladder of tuberculosis. If one kidney is obstructed and its fellow normal, nephrectomy may be the elected procedure. When life is limited even if the patient survives, and when the same, if not better, results can be obtained by *x*-ray and radium without any drastic procedure, why subject a patient with an inoperable carcinoma of the bladder to transplantation plus total cystectomy, unless it is with euthanasia in mind?

I make this statement in spite of the fact that Beer reports excellent results from transplantation of the ureters to the skin with total cystectomy, and that Higgins advocates transplantation of the ureters nto the bowel with total cystectomy in extensive carcinoma of the bladder, saying: "During the past three years, patients whose condition would, in the past, have been considered hopeless and for whom our entire reliance would have been placed on roentgenotherapy, have been given the benefit of cystectomy and transplantation of the ureters with outstanding results in some cases. Cystectomy and transplantation has now been performed in thirty-four cases of carcinoma of the bladder in our series."

In a more recent article, however, reporting this same series of cases, Higgins takes a different stand: "Less radical operative procedures should be employed in advanced cases of carcinoma of the bladder associated with large dilated ureters, pyelonephritis, and impaired renal function. Such vesical carcinomas lie beyond the range of operability for this type of surgical procedure. . . . The question is raised as to the advisability of earlier transplantation of the ureters and cystectomy before irreparable damage to the kidneys has developed."

No one, I believe, could take any exception to Higgins' indications for the operation in early carcinoma of the bladder. However, he does not give his figures concerning either mortality or morbidity.

Yet in spite of the reports of these two men, I still feel that when cancer of the bladder is diagnosed sufficiently early to be curable, transplantation of the ureters with total cystectomy is never indicated.

EPISPADIAS AND EXSTROPHY OF THE BLADDER

When epispadias and exstrophy of the bladder exist, the indication for bilateral transplantation of the ureters into the

bowel is not questioned. I have seen four cases of this condition. In the first instance, the patient was a man in his forties, who, after the situation and risks were fully explained, refused operation. In the second case, the patient was a child of 8 weeks who had a successful transplantation of the right ureter from which he recovered; however, a month later when the left ureter was transplanted, he died of acute obstructive suppurative pyelonephritis. In the third instance, after explaining the situation to the child's mother and obtaining her permission, I treated the baby for twenty-one months to give it the best possible chance for recovery and then operated. Unfortunately, the child succumbed from the operative procedure. The last case, a boy of 13, was admitted to the hospital with the bladder closed but the penile condition not corrected. The boy was a social outcast and his teachers would not have him in school. I tried to correct the defect in the penis and bladder neck, unsuccessfully, due to lack of coöperation on the part of the boy. The parents then consented to a transplantation. This patient lived.

Case v. R. M., age 8 weeks, was admitted on October 10, 1930, for correction of epispadias with partial exstrophy of the bladder.

On October 27, an unsuccessful attempt was made to repair the exstrophy and epispadias by the Young technique. On November 13, the right ureter was transplanted by a modified Coffey-Mayo technique. The child ran a septic temperature for four or five days and urine drained from the rectum. The temperature then subsided to normal and the child voided from the rectum four or five times a day.

On December 11, the left ureter was transplanted, and again the child ran a septic temperature. He died on December 23 of acute pyelonephritis.

Autopsy. The autopsy was negative except for the following findings: The ureter transplant on the right side was healed with normal ureter and kidney. The left ureter was healed with no leakage, but the last suture bringing the layers of the bowel together had been placed too tightly, completely obstructing the ureter at this point. The kidney on this side showed marked inflammatory and destructive lesions in the upper pole with much inflammatory reaction and minute abscesses scattered through the parenchyma. Microscopic examination showed a normal, non-inflamed right kidney. Death had been due to left obstructive ureteropyelonephritis.

Case vi. B. B., female, age 5 weeks, was admitted to the hospital on May 10, 1935. The chief complaint was irritability and excessive crying as the result of a congenital deformity—exstrophy of the urinary bladder. Nothing else was significant in the past history.

The mother and father were 19 and 22 respectively, and in good health. There was one other child, a boy, aged 2, alive and well. No history of any familial disease could be obtained.

The infant was poorly nourished, and showed no evidence of the umbilicus—a small hernia at the upper end of the bladder probably represented it. The posterior wall of the bladder was present in the lower abdomen; the mucosa appeared reddened and the ureters were draining. The urethral opening could be seen at the apex of the trigone. The external genitalia were rudimentary, pads of fat representing the labia. Another deformity was found on *x*-ray examination, a congenital absence of both pubic bones and their rami. The spine was normal.

Seven days after admission, the child developed a generalized rash which looked very much like measles. About eight days later, a high septic-type of temperature developed, which rose to 105 degrees; this receded on the third day. Bronchopneumonia was suspected; but later pyelitis developed.

From this time until the latter part of October, the course was fairly smooth; the child then had a temperature for about nine days.

Upon admission, the child weighed 8 pounds 3 ounces. She gained weight rather slowly but steadily, attaining her best weight of 23 pounds 2 ounces in January, 1936. From this time until operation the weight remained stationary.

The laboratory work was essentially negative except for the presence of albumin and red blood cells in the urine.

In February, 1937, her condition was such that we performed a transplantation of the right ureter by the matchstick technique. The child's condition was poor following the

operation and she appeared toxic and dehydrated. The pulse was poor and respirations rapid. She expired on February 28, 1937, from shock and ileus.

X-ray examination soon after admission showed normal function of both kidneys.

On March 24, a plastic repair of the epispadias was done. The child's condition following this operation was good. He ran a slight temperature for a few days; some infection about the penis cleared. The incontinence still remained. As the child's general condition gradually improved, on April 24 both ureters were transplanted by the matchstick technique.

FIG. 1. Pyelograms taken shortly after both ureters were transplanted into rectum. These show definite nephrotic changes as compared to pyelograms taken before operation.

Autopsy corroborated the diagnosis of paralytic ileus. The implant seemed normal and there was no definite peritonitis.

CASE VII. R. M., male, age 13, was admitted to the hospital on March 5, 1937, with chief complaints of incontinence of urine and a deformity of the genitalia (epispadias). The patient had never any control of urination.

Past medical history and family history were both essentially negative.

Physical examination revealed a suprapubic scar from a previous operation for correction of the epispadias. The body of the penis was adherent to the abdominal wall and the urethral opening was very close to the abdomen. There was no body to the penis, scar tissue covering it and only the glans protruding.

Comment. Among these four patients one had learned to live a solitary life and preferred life as it was to the chance of death, and the other three were children. Personally, I am glad the little girl and boy died. The other child, 13 years of age, has been turned into a fairly normal boy, although the penile condition should be corrected at some future time. There is now definite nephrosis of both kidneys,

which may prove fatal in the event of serious illness. In spite of this, he is free from pain, he can control his rectum; he voids and defecates four times daily and has perfect night control. He is a favorite now with the other children. The mortality rate was 66⅔ per cent and the morbidity cannot at present be ascertained. Certainly the surviving patient's kidneys have suffered considerable damage as a result of the transplantation and only time will tell what the outcome will be.

Fig. 2. Pyelograms taken ten months after bilateral transplantation of ureters into rectum. These show marked nephrosis. The end result will be death due to infection or renal insufficiency. At present there are no physical signs of either and the boy is apparently perfectly well and symptom-free. Prognosis is bad.

Tuberculosis of the Bladder

There are a series of patients who have tuberculosis of the kidneys and bladder upon whom nephrectomy is indicated. As a rule, if the opposite kidney is involved the lesion seems to heal if the more involved organ is removed. The tuberculous cystitis also heals but often the bladder is so contracted that the subjective symptoms of frequency, urgency and pain are as bad or worse than before nephrectomy. This is due to the healing fibrosis of the bladder wall limiting bladder capacity. In these cases I unhesitatingly transplant the ureter of the remaining kidney into the bowel. My results have been very gratifying. Out of four cases, three are alive and well. Two were operated upon ten years ago, and the third one year ago. In my opinion, transplantation is definitely indicated in this type of case.

Case viii. A. W. A., male, age 45, was admitted on January 20, 1928. The diagnosis

was left renal tuberculosis and tuberculous cystitis, confirmed by complete cystoscopic study. All the laboratory reports showed tubercle bacilli in the urine. On January 25, a left nephrectomy was done. The patient was discharged February 18, with a healing tuberculous cystitis.

He returned to the hospital on April 28. The bladder was lavaged and over-distended; its capacity was about 1 ounce. Tubercle bacilli were found in the urine. The same treatment was again carried out on April 30 and May 8 when few tubercle bacilli were found in the urine. Some days there would be three plus albumin, other days no albumin. All urine was highly acid and loaded with blood cells. The urea was 12.2; creatinine 1.2; sugar 115; the Wassermann negative. Cystoscopic examination showed the bladder very much improved over the condition at the time of operation. The left ureter was obstructed 3 cm. above the bladder, with a tuberculous fistula at the site of operation. The tuberculous cystitis was improving.

On May 12, the patient was discharged with a diagnosis of cystitis, tuberculosis of the stump of the left ureter and sinus in the old wound.

On November 16, he was again admitted with a diagnosis of tuberculosis of the bladder. The capacity of the bladder was about 1 ounce. No tubercle bacilli were obtainable from the urine. The patient's chief complaint was frequency of urination. The tuberculous fistula in the flank was healed.

On November 19, the right ureter was transplanted into the rectum, according to the more elaborate Coffey method. For a few days following the operation the patient had some elevation of temperature and some rapidity of the pulse. The catheter came out on the tenth day and the rectum acted as a perfect reservoir for the urine. There was no excoriation around the anus. The patient was perfectly comfortable, emptying the rectum about three times a day and once at night. There was no need for cathartics.

On January 1, 1931, the patient was perfectly well, doing hard, manual labor. His rectum accommodated from 8 to 12 ounces of urine which he had no difficulty retaining.

Case IX. J. S., male, age 37, was admitted to the hospital on June 6, 1928. The cystoscopic diagnosis was tuberculosis of the bladder, left renal tuberculosis, and left tuberculous epididymis. Many tubercle bacilli were found in the urine.

On July 2, a left nephrectomy was done Section revealed caseocavernous tuberculosis. Examination on July 14 showed no evidence of tuberculosis in the lungs.

On August 9, a radical operation was done on the right testicle and vas; the left and the right seminal vesicle and both epididymi were removed. Section of all tissue revealed tuberculosis. The albuminuria persisted during the patient's stay in the hospital but cleared up before he was discharged, and the tubercle bacilli disappeared from the urine. Following the nephrectomy and the radical removal of the vesicles and epididymi, the patient was discharged in fair health.

On January 10, 1929, he was again admitted to the hospital with a diagnosis of tuberculous cystitis. He was studied cystoscopically and found to have a very badly contracted bladder, which could not be distended with over 1½ ounces of water without great pain.

The right ureter was transplanted into the rectum by the Coffey catheter technique and the appendix removed on January 14. There were no tubercle bacilli in any of the specimens of urine. Following the operation he had an elevation of temperature for several days. The catheter came away on the fourteenth day and the rectum acted as a reservoir for the urine. The patient made an uneventful recovery and was discharged on February 7, 1929.

On June 6 he reappeared and a diagnosis of possible pulmonary and renal tuberculosis was made. However, all laboratory findings and the *x*-ray of the chest were negative.

On October 22, *x*-ray findings still showed nothing suggestive of tuberculosis. At that time the vertebrae were *x*-rayed for possible tuberculosis of the bone, but this also was negative. The red blood cells were 4,720,000; white blood cells 5,000; polymorphonuclears 68 per cent; lymphocytes 26 per cent. The urea nitrogen was 21.4; sugar 90; the Wassermann negative.

The patient was voiding three or four times a day through the rectum. No cathartics were needed for bowel movements and he was able to hold from 8 to 10 ounces of urine in his rectum comfortably. There was no excoriation around the anus.

In December, 1930, the patient returned to the hospital for a uroselectan observation. The plates were very poor but sufficiently distinct eighteenth. Autopsy revealed a healed normal transplantation, but the patient died of a general miliary tuberculosis.

Fig. 3. Pyelogram showing bilateral tuberculous pyonephrosis prior to treatment by tuberculin. One year after this picture was taken the right kidney was removed.

Fig. 4. Right kidney has been removed. Left kidney is markedly nephrotic. The bladder can be seen as a small calcified body in the pelvis. Capacity a few c.c. Constant dribbling. Still tubercle bacilli in urine. Pictures taken just before transplantation of left ureter into rectum.

to show a perfectly normal pelvis with some slight dilatation of the ureter. He was in perfect health and doing manual labor.

Case x. M. M., male, age 65, came to the hospital on March 1, 1935, with pulmonary tuberculosis and a discharging sinus from both testes, accompanied by frequency, urgency and painful micturition.

Examination revealed a right tuberculous caseocavernous nephrosis, marked tuberculous involvement of the bladder, pulmonary involvement, and a chronic myocarditis. The left kidney and ureter were normal. After careful study I decided to reverse the treatment. On March 8, I carefully transplanted the good ureter from the left kidney into the bowel. The patient made an uneventful recovery from the transplantation. As the right kidney was more or less completely destroyed, virtually all of the urine came through the rectum with much relief from the bladder symptoms. It had been planned to remove the tuberculous right kidney, ureter, and epididymi at a later date. On the fifteenth, seven days after the transplantation, the patient began to run an elevated temperature and pulse and died on the

Case xi. D. W., female, age 8, was admitted to the hospital on January 4, 1937. The chief complaints were pain over the lower abdomen and hematuria of two weeks' duration. Eighteen months previous to this admission the child had been brought to the hospital and a diagnosis of bilateral tuberculosis and tuberculous cystitis was made. The child was inoperable at that time and had been returned home under the care of the family physician who was instructed to place her upon a rigid antituberculous régime and to use Koch's old tuberculin as treatment. After fourteen months, she was readmitted to the hospital. A bilateral pyelogram was made, the right kidney was found to be badly involved and almost functionless and was therefore removed. An uneventful recovery ensued and at the time of her discharge the tubercle bacilli had disappeared from the urine. The caseocavernous type of tuberculosis was noted.

Readmission was necessary because of pain, frequency and constant dribbling. Physical

examination was essentially negative, but *x*-ray examination by oral urography indicated an advanced pyelonephrosis and a small contracted bladder with a fine calcification of the bladder wall. A few tubercle bacilli were found in the urine. It was decided that this bladder could not be improved by any form of treatment and that the left ureter should be transplanted into the rectum in spite of the fact that there was indication of some active tuberculosis in the left kidney, with the possibility that the ureter might be involved. On January 27, the left ureter was transplanted and the abdomen was closed in layers. Strangely enough, the ureter looked perfectly normal. Following the operation the patient ran a temperature from 101 to 103°F. for nine days; eighteen days later, on February 24, she was out of bed and was sent home greatly improved.

A year later she returned to the hospital for a checkup. Her weight was 62 pounds, a gain of over 12 pounds since the original operation.

Fig. 5. Fairly normal pyelogram taken a year after transplantation of the left ureter into rectum. Note the difference between this and pyelogram in Fig. 4. This seems to be a fairly normal kidney. No tubercle bacilli in urine. No symptoms.

There was no elevation of temperature; her appetite had very much improved; about seven watery stools were passed each day, but there was no incontinence except with coughing or sneezing. She had one bowel movement at night which was watery and which contained little fecal material. Slight excoriation had developed around the anus. Food did not stimulate defecation reflex except in the morning. The pyelogram showed marked improvement in the left kidney.

Comment. The two cases seen in 1930 were adult males, both laborers. They both still work at hard labor; their rectums act satisfactorily as bladders and they are with-

out symptoms. They have perfect control and never wet the bed; they have about four bowel movements daily and are never required to take a laxative.

The third case needs a little comment. I thought it would be good treatment to get the good ureter transplanted before attempting removal of the balance of the active tuberculous urogenital tract. Had I succeeded the idea would have been unusual and the result brilliant. The development of the miliary tuberculosis following the operation cannot be attributed to squeezing tubercle bacilli into the blood stream because no tuberculous tissue was handled. This seems to favor Henline's reasoning that a miliary tuberculosis following removal of a tuberculous kidney is not due to the dissemination of the bacilli by handling. The operation was perfectly successful.

The last case, the little girl, had renal tuberculosis with cystitis, and when she was first seen any surgical procedure was out of the question. An antituberculous régime and Koch's old tuberculin improved her condition in a year, and the worse kidney was then removed. After the operation, the bladder symptoms were as bad as ever; we did not know whether this was due to the infection from the remaining kidney or from the contraction healing of the bladder. Finally the child became totally incontinent. Transplantation of the ureter was decided on, even though this organ might be the seat of a tuberculous process. The operation was a perfect success and today the child has gained 35 pounds, is perfectly continent while awake but does wet the bed once nightly. She is a happy, contented girl and is advancing rapidly at school. I believe as she grows older she will learn how to use her rectum as a bladder at night.

Certainly, without transplantation of the ureters this child would have gradually developed a stricture of the ureter, dilatation of the ureter, a continuation of her renal tuberculosis and an early death from urogenital sepsis. The pyelogram taken a year after the tuberculosis gives no reason to believe that this kidney is not healed and that the rectum will not be a perfect reservoir for the urine.

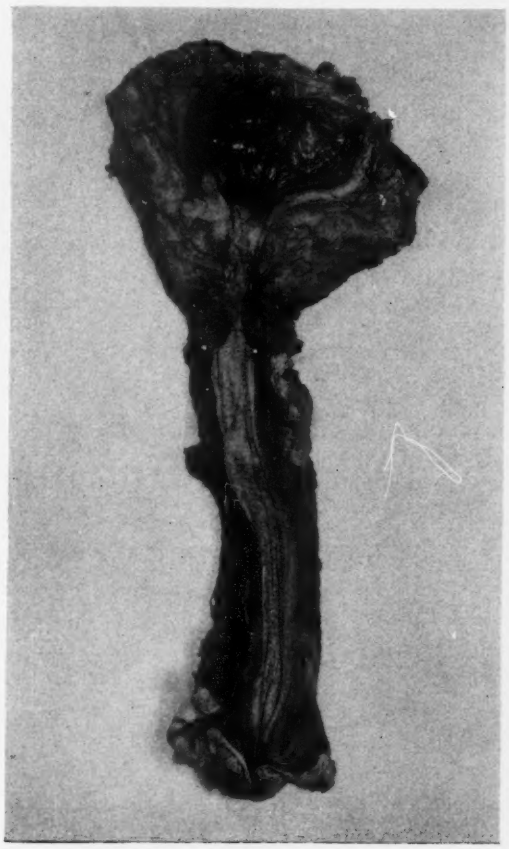

Fig. 6. Bladder and penis in Case xii. Postmortem specimen showing the contracted interstitial cystitis.

INTERSTITIAL CYSTITIS AND CONTRACTED BLADDER

One of the indications for transplantation of the ureter is interstitial cystitis in which the frequent, painful micturition is so burdensome as to make life almost unbearable. The following case had been under the observation of Dr. Braasch at the Mayo Clinic for a number of years. Everything possible in the way of palliation for the interstitial cystitis and contracted bladder, including resection of the presacral nerve, had been done, without affording much relief. Transplantation of the ureters into the sigmoid with later excision of the bladder was therefore advised. Dr. Braasch

referred the patient to me because he wished to be nearer home during his hospitalization.

Case XII. C. A., male, age 34, had as his chief complaints burning on urination and dysuria.

The patient was in his usual good health until the age of 19, at which time he contracted gonorrhea. He had a discharge for a period of one month. About two months later, he fell about 45 feet from a building and landed partly on the perineum. After a few months he began to have difficulty in urination, frequency (several times a day) and dysuria. This continued gradually to get worse. Three years before I saw him, at the age of 31, he had had a presacral ganglionectomy at the Mayo Clinic. This operation, he stated, aided him for about six months, but the dysuria and frequency recurred. In February, 1938 he underwent another operation at the University of Pennsylvania Hospital (the nature of which was not determined). This gave him no relief. He had no discharge or hematuria.

The pain on urination was a dull, heavy, bearing-down one which radiated to the genitalia.

The past medical history was essentially negative except for a history of enuresis at the age of 12. Besides the above operations, a tonsillectomy had been done.

Physical examination revealed tenderness present in the midline over the lower third of the abdomen. An inguinal lymphadenopathy was present, and the prostate gland was enlarged.

The blood picture was essentially negative, as was the Wassermann. The blood sugar was 60 mg. per 100 c.c. and the blood urea nitrogen 18.9 mg. A catheterized specimen of urine showed albumin, a moderate amount of sugar and a few red and white blood cells.

On *x*-ray examination, there was no evidence of opaque calculi, but an amorphous calcified density was present low in the right pelvis which might have been in the bladder or adjacent to the bladder. Intravenous pyelogram showed satisfactory kidney function and normal morphology.

The temperature, pulse and respirations were normal. The blood pressure was 120/68. In the hospital, he still suffered as he had upon admission and he also appeared quite nervous.

On July 23, ten days after admission, the diagnosis of interstitial cystitis having been verified, he was operated upon. The bowel was packed away and peritoneal adhesions were found anchoring the sigmoid colon to the left pelvic wall. These adhesions were loosened. The left ureter was found, cut close to the bladder and then transplanted into the bowel. A cigarette drain was inserted and the abdomen closed in layers.

The patient's condition was fairly good immediately following operation. The temperature, pulse and respirations remained normal and there was a total drainage of 22 ounces the first day. However, the next day, the patient's temperature rose to 101 degrees, his pulse rose and he complained of abdominal pain and "gas pains." On the third day, hiccoughs developed and he vomited on several occasions. These symptoms continued, his pulse became irregular, and on the fifth day he became irrational. He died on July 31, eight days after operation.

Autopsy. It was evident that the death was not due to a mechanical obstruction but to paralytic ileus. The upper two-thirds of the jejunum were much dilated, but there was no evidence of peritonitis except the mechanical evidence that would go with a paralytic ileus. Nothing could be cultured from the peritoneal fluid.

Comment. This case brings out several very important facts. The first, of course, is the definite difficulty that may be encountered in ureteral transplantation secondary to former abdominal procedures. These procedures, particularly pelvic ones, may easily spoil an operation of this type and must be heavily weighed in making a decision. Second, the regeneration of the presacral ganglion with return of pain six months after ganglionectomy is a valuable observation. How often does this happen? If this can happen once, may it not happen more often than we think? Can we then consider that this surgical procedure must be a more carefully selected one? Did this operative procedure plus the regeneration have anything to do with the irritability of the bowel during operation and the paralytic ileus afterward? Is it not

possible that preliminary transplantation of the ureters instead of ganglionectomy in these cases of interstitial cystitis may not be the proper procedure?

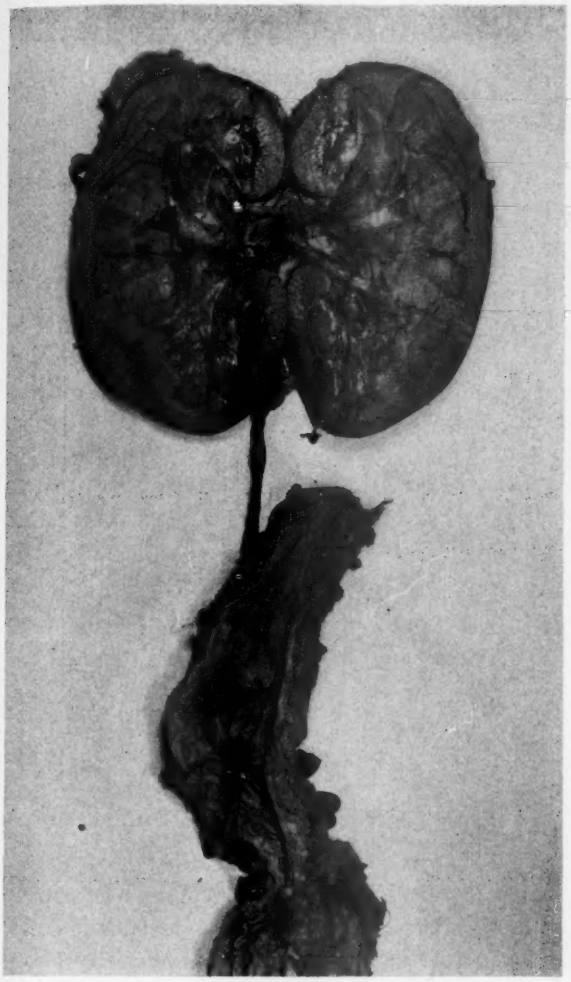

Fig. 7. Right kidney and ureter showing transplantation of ureter into bowel. Post-mortem specimen.

Probably the only possible chance for relief that this boy had from the beginning was transplantation of the ureters. Even though the presacral ganglionectomy had relieved him of his pain, it could never relieve him of his interstitial cystitis nor his contracted bladder; it is doubtful if such a condition is ever curable and if it is curable, the final condition of the bladder will be such that the frequency of urination will be as uncomfortable as is that frequency and urgency which we obtain in the healed contracted tuberculous cystitis. This, then, is a definite indication for transplantation of the ureters.

MORTALITY AND MORBIDITY

All told, I have operated on thirteen patients, with sixteen separate operative

Fig. 8. Regenerated presacral nerve. Post-mortem specimen.

procedures and seven resultant deaths. Two of these cases were exstrophy of the bladder operated on successfully for other men at other hospitals. The ureters were transplanted separately, making a total of four operative procedures. The patients left the hospital alive, with their rectums functioning. The end results in these two cases is unknown to me.

This report deals only with the cases of which we have permanent records and have been able to follow. There are eleven cases in this series with twelve operative procedures and seven deaths. In several of these cases the operative procedure has been a success but the patients have died of conditions other than those caused directly by the transplant operation. Yet I consider them as transplant mortalities.

All deaths have been autopsied (in itself rather an unusual accomplishment). From a study of these reports, it is my belief that infection does not play such an important rôle in our failures if we are

careful in our suturing and have no bowel or urinary leakage into the peritoneal cavity after operation. Two of the cases had some localized peritonitis at autopsy, which the pathologist felt had nothing to do with the cause of death, and which I believe would have been completely controlled had the patients survived other conditions. As it is a virtual impossibility not to contaminate in some degree the operative field in any of these operations, it can be seen by the study of these few cases that peritonitis per se is usually not due to soiling at the time of operation. Since none of our anastomotic connections had leaked, peritonitis was not the principal cause of death in any of our fatalities.

All of us who have done experimental transplantations upon dogs have found that most of the dogs died of peritonitis. This I think is due to the fact that it is very difficult to do perfect transplantations on these animals because of anatomic difficulties. I agree with Hinman that the elaborate aseptic technique of Higgins is not necessary for the prevention of peritonitis in the human. I do not believe that it makes any particular difference whether or not there is slight soiling at the time of the operative procedure because it is almost a physical impossibility under any form of technique, even that of Higgins, to do this operation without some contamination of the field.

The most frequent cause of death in the series was ileus. Three patients died of this condition and one other died of definite obstruction. In Case I, a single large band of adhesions, unrecognized either before or at operation, caused total obstruction of the bowel postoperatively. This was probably due to bowel handling at the time of operation. Had I been as careful as I should have been and elicited the real story of this man's constipation prior to operation, I would probably have been suspicious of some such condition and might have had a gastrointestinal study made prior to the transplantation. A simple severance of this single band of adhesions would have prevented an otherwise successful transplantation of the ureters from becoming a fatality. Since this experience, all patients upon whom transplantations are planned are given the benefit of a fluoroscopic gastrointestinal survey.

If we stop to consider just what we do in a transplantation I believe it will be easily understood why ileus has been responsible for so much trouble. Intestinal peristalsis is necessary to prevent ileus and many things are done during this procedure to interfere with it. I also believe that our non-residue diets and our frequent enemas in the preparation of these patients for operation is bad, as there is no doubt that atony of the bowel frequently results because of an empty intestine. The stomach should be empty prior to surgery and so should the sigmoid, but it is a desirable thing ordinarily speaking, to have an intestine partially filled. The packing off of the bowel, the occasional difficulty with straining and evisceration requiring too frequent manipulation of the gut, the clamping of the sigmoid, and the length of time that it requires to complete these surgical procedures, are all predisposing factors in ileus.

What can we do then to prevent ileus? First, the simplest technique possible; second, packing the bowel from the field of operation should be done gently, taking such precautions as to prevent retching and straining, so that repacking does not become necessary. One of these patients had to be repacked four times (Case XII) because of this condition, and I knew that he probably would have a paralytic ileus. All adhesions that bind down the intestine should be carefully freed; all raw surfaces should be covered; if drains are left in, the omentum should be replaced between the small bowel and the drain insofar as possible, and the drain should be placed so that it is not surrounded by coils of intestine.

In two of these patients who succumbed to ileus there had been previous lower abdominal surgery. In both cases the

sigmoid was bound down by dense adhesions. The freeing of these adhesions added to the time of operation and made it much more difficult fully to expose and transplant the ureters. In neither of these cases was there any leakage and only a little local peritoneal irritation. Previous abdominal surgery must therefore be carefully considered when this type of surgery is planned.

One patient died a heart death, probably due to the length of his anesthetic and his operative procedure, but this patient might possibly, had he lived, succumbed to a peritonitis, this being the only case which seemed to have any degree of peritoneal involvement. Prior to the autopsy there was no reason to believe that he had any definite peritoneal involvement.

Case VI died as much from operative shock as from the ileus that was present.

Case V died as a result of an acute obstructive suppurative urethritis and pyelonephritis. A stitch tied too tightly in the bowel completely constricted the left ureter. Several weeks before the right ureter had been successfully implanted. This is definitely an error of operative technique which should not have occurred.

Case X died of a miliary tuberculosis which started seven days after his ureter had been successfully and correctly transplanted. Although the death is recorded as a transplantation death, the transplant site was found to be perfectly normal. There is no doubt that the miliary tuberculosis was the cause of death. Had I this case to do over again I would probably have removed the right tuberculous kidney, the vesicles and epididymi prior to the transplantation and my patient would probably have died of a miliary tuberculosis before I would have had an opportunity to have attempted transplantation. This case is additional evidence supporting Henline's reasoning that miliary tuberculosis is not due to the squeezing of tubercle bacilli into the circulation when a nephrectomy is done for this disease. Here no tuberculous tissue was handled at any time and for that reason tubercle bacilli could not have been squeezed into the blood stream.

A careful study of these seven deaths with their autopsies reveals some very interesting facts. There is no doubt in my mind that quite a number of these cases might have been successful transplants had the operator had more transplantation experience. Certainly peritonitis in the human being should very seldom be the cause of failure. Ileus might be prevented by more careful preoperative preparation, by more gentle handling of the abdominal contents at the time of operation, and by a very simple technique such as the Hinman or the Match-Stick technique, as I call it. All of these operations follow the general principles as advocated by the experimental and clinical experiences of Coffey and Mayo. Leakage certainly has been no factor; shock and cardiac failure and miliary tuberculosis as complications are rather difficult to prevent.

A short review of the successful cases reveals some very interesting facts. Concerning peritonitis as a result of contamination at the time of operation: the most successful case, Case VII, due to lack of coöperation, at operation had a rectum with considerable feces in it. This was washed out as thoroughly as possible before the bowel was opened but in spite of everything that could be done there was contamination to such a degree that I placed drains down to the site of the transplants. He made an uneventful recovery. No doubt there was some localized peritonitis for a few days, but nature took care of it.

The more elaborate the technique, the greater is the chance for trouble. Most of my surviving patients had operations which took less than an hour. In all but two of these cases that died the operative procedure lasted over an hour. From my very small experience I would feel that, all other things being equal, the ureters should be transplanted separately. It ought not to take a skilful man longer than a half hour to transplant one ureter if there are no

adhesions and if he uses a simple technique, such as the Mayo modification of the Coffey, the matchstick, or Hinman technique. It is my belief that the matchstick technique with the wide open oblique cut of the ureter is a little better than the Hinman technique with the ligature around the ureter cut after it is in the bowel. At least I believe that the end of the ureter should be left wide open with an oblique opening

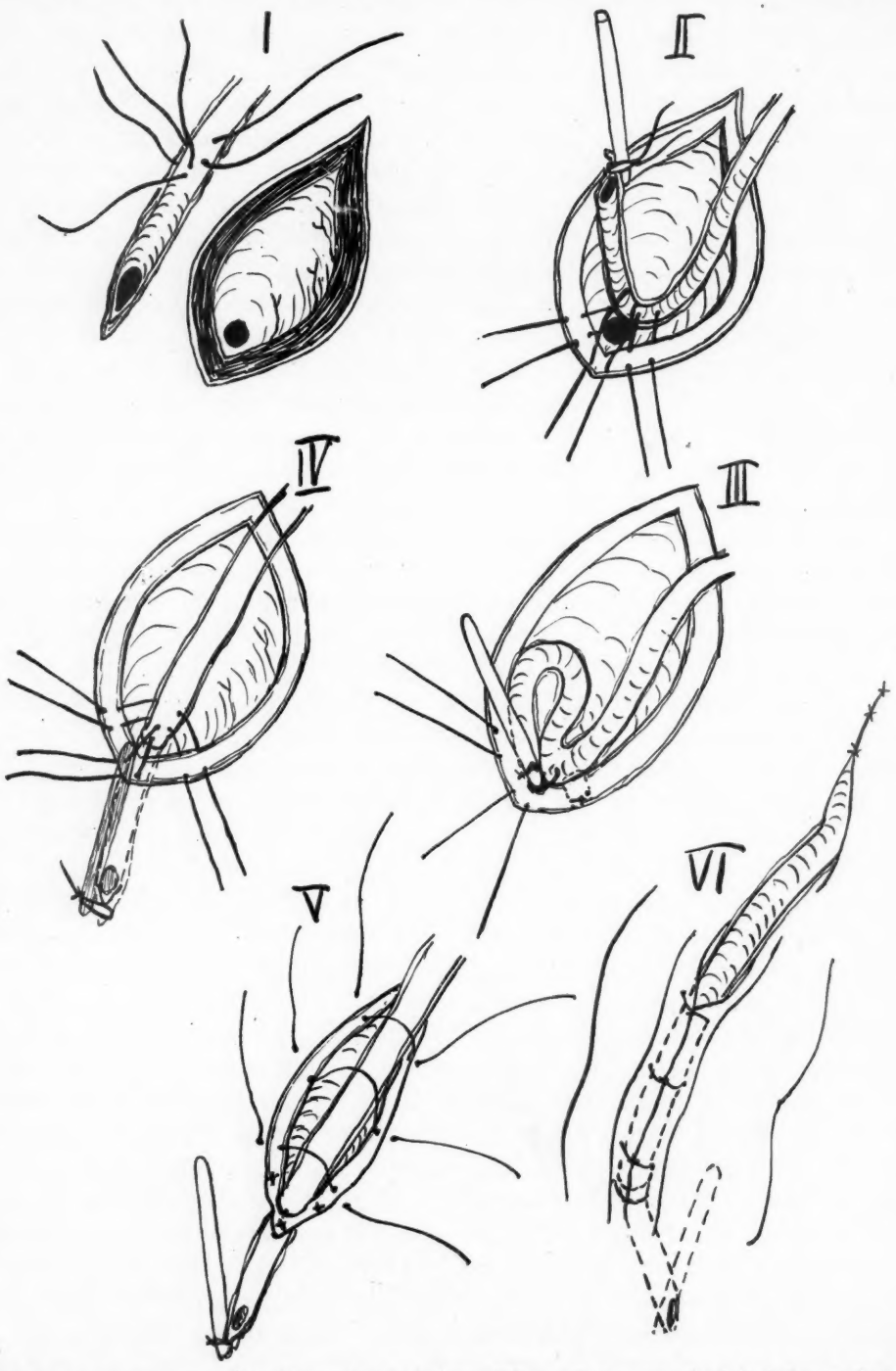

FIG. 9. 1, sutures are placed in ureter and sigmoid is opened. 2, matchstick tied to end of ureter and sutures placed to hold ureter in bowel. 3, inserting free tip of ureter into bowel. 4, tip of ureter in lumen of bowel sutures now tied. 5, sutures placed in bowel to hold ureter against mucosa and underneath muscularis. 6, wound in bowel closed.

instead of tying it off as Hinman does. However, the Hinman modification of Coffey's technique is perhaps the best yet. I believe that if his little adaptor were fastened to the cut end of the ureter in the same way as I fasten the matchstick his results would be even better.

TECHNIQUE OF OPERATION

The patient is prepared for several days with simple cleansing enemas. Forty-eight hours before operation an ounce of castor oil is given. About six hours before operation, the bowel is carefully irrigated with plain water. As soon as the abdomen is opened and the bowel is packed away, the anesthetic of choice being spinal, the sigmoid is clamped and the bowel is again carefully washed out with water until the washing becomes clear. If there are any large pieces of feces in the bowel at that time they are flushed out through a proctoscope. The ureter to be implanted is then dissected free without any attempt being made to strip it of its periureteral fascia and fat. It is cut off as near the bladder as possible. The bowel is then prepared according to the Coffey technique. Sutures are placed very much in the fashion that Hinman places his, first three sutures into the ureter through the submucosa and muscularis. (Fig. 9.) The ureter is then obliquely cut after it has been fitted to the incision in the bowel, leaving about an inch to protrude into the lumen of the bowel. The bowel is blown up very gently with air and the mucosa is punctured with the cautery. Through this opening the ureter and the matchstick are plunged into the lumen of the bowel and manipulated until the matchstick disappears within the lumen when the sutures are tied holding the ureter to the submucosa and the muscularis. It may be advisable to put in one or two other sutures to hold the ureter in its bed as per the Hinman technique. The muscle is closed, usually with interrupted sutures over the ureter; one must make sure not to constrict the ureter when tying the sutures. A drain may or may not be placed in the cul-de-sac, depending upon the operator's judgment. This is a simple speedy technique and in my opinion offers the best chance for success.

All operations in this series were done by the Coffey catheter, the Coffey-Mayo, or the matchstick technique. Of those that survived, two were done by the Coffey catheter, one by the Coffey-Mayo and three by the matchstick technique.

CONCLUSIONS

Transplantation of the ureters into the bowel as an operative procedure should be considered only when a condition exists which makes life sufficiently miserable that death is usually to be preferred. The operation, even with the simplest efficient technique, in the hands of the most skilful, is not without a very high mortality and morbidity. It is rarely indicated in cancer of the bladder and vesicovaginal fistulae. It is more frequently indicated in the contracted bladder due to the healing of a tuberculous cystitis, and in this class of patient there is a low mortality with very satisfactory symptomatic results. It is also indicated in intractable and incurable cases of interstitial cystitis. It is a valuable procedure in exstrophy of the bladder and epispadias, but should never be used in the adult exstrophy without a complete explanation of both its mortality and morbidity and should be an operation elected by the patient.

Note. Since the completion of this paper a new technique has been described by Farrell and Lyman (*Surg., Gynec. & Obst.*, 66: 657, 1938). This technique is described as an aseptic uretero-intestinal anastomosis. The operation was done on seven dogs and all survived. At the end of six months all but two dogs were killed and autopsied. The technique is modeled after the Eck fistula, an anastomosis of the portal vein and the inferior vena cava. While the procedure has given good results in this series of dogs, it apparently has never been applied clinically. The technique seems to be rather difficult and time consuming and

I do not like the blind use of the silk ligature to create the opening in the ureter and bowel. I can see no advantage over the Higgins technique, and believe this new one to be even more difficult and complicated.

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TREATMENT OF INTRACTABLE SCIATIC PAIN DUE TO PROTRUDED INTERVERTEBRAL DISCS*

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SCIATICA, or pain over the posterior aspect of the hip, thigh, and leg, is a very common complaint, producing both acute and chronic discomfort. This pain is not only characterized by its resistance to treatment, but also by the fact that it can be a symptom of so many disease entities. The sciatic nerve is, of course, the longest nerve in the body; it arises from the primary divisions of the fourth and fifth lumbar nerves and the first and second sacral nerves, and it is subjected to trauma, strain, distortion, infection, and compression. For this reason, many underlying causes produce irritation to the nerve and its component parts, intraspinally, within the pelvis, and externally. The term "sciatica" evidently was evolved from the term "ischias," which was used by the ancients in referring to all painful conditions of the thigh and hip; as a consequence, there is a tendency to include many irrelevant conditions under this title. For that reason the term "sciatica" should be used to signify a symptom without any indication of the underlying cause.

Formerly it was customary to divide all cases of sciatic pain into a primary and secondary group. In the primary group were placed all the so-called idiopathic cases, or those in which the pain was apparently due to pathologic processes involving the nerve elements primarily. In the secondary group were placed all cases in which the underlying cause could be traced to a lesion of the contiguous bony or muscular structures and in which the nerves were involved secondarily. Of recent years, the primary group has dwindled as our knowledge of the many and diverse lesions of the bony and muscular structures which produce irritation of the sciatic nerve has increased.

Ghormley,[9] in discussing low back and sciatic pain from an orthopedic standpoint, divided the types of conditions and lesions which may be the underlying cause into seven divisions: In the first division he placed acute and chronic strain due to lumbosacral or sacro-iliac lesions. In the second division he placed all types of trauma. Trauma involving the vertebrae, such as fractures of the body, pedicles, laminae, or facets, he considered fairly obvious with regard to the diagnosis because of the history and roentgenologic findings. Trauma involving the joints and producing traumatic spondylosis he also considered fairly obvious. Traumatic conditions involving the intervertebral discs, however, including narrowing and avulsion of the disc and rupture of the nucleus pulposus, are sometimes difficult to diagnose and almost always require the combined efforts of the orthopedist, neurologist, and neurosurgeon before the proper diagnosis and treatment can be carried out. Under infections Ghormley included infectious arthritis, fibrositis, typhoid fever and tuberculous spine. Metabolic and senescent conditions included hypertrophic changes and osteoporosis with pathologic fracture. Congenital anomalies included spina bifida, sacralization of the fifth lumbar vertebra or lumbarization of the first sacral vertebra, and anomalous facets; these are conditions that can be demonstrated in the roentgenograms. Neoplastic conditions he divided into the benign and malignant.

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Under benign neoplasms were osteoma and osteochondroma, giant-cell tumor, and hemangioma; these are usually evident in the roentgenograms. Under malignant tumors was metastasis from other nalignant lesions in the body; this is sometimes difficult to diagnose. Myeloma and primary osteogenic sarcoma are evident in the roentgenograms. Ghormley's last classification included such neurologic conditions as tumor, inflammation, and degeneration of the spinal cord.

In addition to the orthopedic conditions which may produce sciatic pain are the constitutional or systemic causes, which include such conditions as diabetes, syphilis, and gout, and forms of toxic neuritis which develop following the absorption of alcohol, lead, or arsenic. Shelden has called attention to the presence of either primary or metastatic pelvic tumors which may produce severe sciatic pain and which can only be identified by the routine use of rectal examinations.

It is apparent, then, that the underlying cause of sciatic pain is quite frequently discovered during a comprehensive physical examination. The general examination, including careful observation of motion, tenderness, and the abnormal appearance of the back and lower extremities, together with comparative roentgenograms of the lower part of the spine and sacrum and neurologic examination to evaluate any motor or sensory changes in the muscles subserved by the sciatic nerve, may lead to a definite diagnosis. In a relatively moderate sized group of cases of sciatic pain the cerebrospinal fluid must be examined in order to make the diagnosis. In these cases spinal puncture is carried out with the patient in the prone position, and usually at the fourth interspace; the manometric pressure is taken before, during, and after compression of the jugular veins (Queckenstedt test) to determine the presence or absence of intraspinal pressure producing partial or complete subarachnoid block. The cell count of the cerebrospinal fluid is important in differentiating inflammatory from other irritative lesions. Estimation of the total protein is likewise important because, in the case of many irritative lesions, the increase in total protein is the only indication of the condition.

Before determining definitely whether the underlying lesion causing the sciatic pain is of such a nature as to require operation, it is sometimes advisable to carry out conservative therapeutic measures, as previously described by Ghormley and myself. These consist of rest in bed with extension, and the use of a sacroiliac belt, diathermy, and epidural injections. We have observed that patients who, under such conservative management, have an increase in pain either on extension or following epidural injections, usually have an intraspinal lesion requiring laminectomy for relief of their pain.

In recent years attention has been called to the rôle of protruded or herniated intervertebral discs in the etiology of intractable sciatic pain. In many cases in which patients have heretofore been classified as having idiopathic sciatic pain and have been treated by various methods, with or without temporary or palliative relief, sciatic pain has probably been due to this definite intraspinal lesion. Goldthwait, and Middleton and Teacher, in 1911, called attention to the possibility of protrusion of an intervertebral disc into the spinal canal causing compression of the cauda equina and clinical symptoms. Adson, in 1922, and Stookey, in 1928, reported cases of compression of the cervical portion of the spinal cord resulting from protrusion of intervertebral discs. In 1929 Dandy reported two cases in which protrusion of lumbar intervertebral discs had caused paraplegia, with relief following operation; he stressed the importance of trauma in the production of these lesions. Mixter and Barr, in 1934, and Hawk, in 1936, further emphasized protruded discs as being one of the obscure causes of sciatic pain.

In the Section on Neurology at The Mayo Clinic these intradural fibrocartilaginous masses have been observed for many years. As early as 1924, because of a pathologic diagnosis of fibrochondromatosis or intervertebral disc, these masses were included with extradural tumors of the spinal cord. That trauma plays a rôle in the production of protruded intervertebral disc is an accepted fact, as evidenced in the majority of cases by the history. The explanation for this is that the restraining annulus fibrosus is ruptured or weakened by undue stress and strain, following which the nucleus pulposus protrudes or herniates into the spinal canal, with subsequent encroachment on the nerves.

The intervertebral discs, which act as shock absorbers between the vertebrae, are composed of a nucleus pulposus which is encircled by the fibrocartilaginous structure, the annulus fibrosus. When the spinal column is subjected to stress and strain, the disc may bulge in all directions although, normally, it returns to its natural position where it is maintained by the vertebral ligaments, principally the anterior and posterior longitudinal ligaments. Following trauma to the vertebral column, or during unusual stress or strain, the disc, itself, or its center, the nucleus pulposus, may be extruded beyond normal limits and may fail to return to the original position. The protrusions which cause clinical symptoms are those which occur posteriorly, and they evidently occur most often in this location because of mechanical forces at the time of injury to the spine. Most of the injuries occur when the spine is in flexion, which produces undue stress on the posterior portion of the annulus fibrosus, the anterior portion of the vertebral interspace being narrowed. In this manner the compressible nucleus pulposus is compressed backward against an overstretched and weakened annulus fibrosus, and while the latter may not give way the first time, extrusion may result during subsequent injury.

In making a diagnosis of protruded intervertebral disc many factors are involved; heretofore, only those patients who did not respond to other types of treatment and in whose case a definite diagnosis could not be made were suspected of having protruded intervertebral discs. As is true of so many other clinical syndromes, the number of cases in which the diagnosis is made and treatment carried out is becoming greater because of the fact that the condition is being looked for during the examination. As a result, much time is saved and much needless suffering prevented.

The symptoms of protruded intervertebral disc vary greatly. The chief symptom, however, is root pain or a pain which begins within the spinal canal and is projected peripherally to that part of the body or extremity innervated by the nerve. The pain is often described as sharp or shooting, and it may be increased by coughing, jarring, or sneezing. It may be precipitated or increased by putting tension on the nerve, as by bending the neck or back. This is especially true in cases of sciatic pain in which positive Kernig or Lasègue signs are elicited when the roots of the sciatic nerve are compressed by a protruded intervertebral disc. In testing for the presence of a protruded intervertebral disc as the cause of intractable sciatic pain, the Lasègue test is important. It consists of flexing the thigh upon the abdomen, with flexion of the leg at the knee. If the leg is passively extended, pain will be felt along the course of the nerve, inhibiting movement before complete extension of the leg is secured. This test may also be applied in the sitting position, the patient in attempting to extend his leg complaining of an increase of pain in the affected leg which prevents full extension of the knee.

There are, however, no pathognomonic symptoms of protruded intervertebrals dic. Roentgenograms of the spine are of some value in making the diagnosis, as emphasized by Love and Camp, who analyzed fifty cases of protruded intervertebral disc

proved at operation. In fourteen of these cases plain roentgenograms were negative and gave no assistance in making a diagnosis. In one case the lesion was partially calcified. In the early reports of protruded intervertebral disc it was thought that narrowing of the intervertebral space was of diagnostic significance, but the fact that such narrowed intervertebral spaces are evident in cases in which no clinical signs of protruded intervertebral disc can be found and that they have been found to be multiple in so many cases, shows that it is of little significance. Hypertrophic changes and compression fractures are also of little diagnostic value.

The most important roentgenologic phase of the diagnosis of protruded intervertebral disc according to Camp,[3] is interpretation of the lipiodol studies. In many clinics such studies are considered essential in making a preoperative diagnosis of protruded intervertebral disc. The introduction of air into the subarachnoid space of the lower lumbar and sacral spine has, according to Fay and Pancoast, also proved of value in localizing and diagnosing protruded intervertebral discs in some neurosurgical clinics.

In order to localize the lesion and definitely establish a preoperative diagnosis it seems necessary to inject radiopaque oil and examine the patient under the fluoroscope as well as make multiple roentgenograms in different positions. The use of lipiodol indiscriminately in all cases of persistent sciatic pain is not to be recommended; this test should be made a part of the general examination and be used only when the clinical examinations indicate it as necessary.

In a review of our cases of tumor of the spinal cord at the Mayo Clinic, I[5] emphasized the danger of the indiscriminate use of lipiodol, but I indicated that, in properly selected cases, the information gained by its use outweighs any of its dangers or disadvantages. Camp has emphasized the necessity of using sufficient radiopaque oil (5 c.c.) to fill the subarachnoid space at any desired level in order to visualize small nonobstructing lesions which can be identified by a filling defect. This filling defect assumes a characteristic shape, depending on whether the lesion is extradural, intradural, or intramedullary. Since the majority of protruded intervertebral discs do not produce obstruction and occur in a region where the spinal canal is really large, it is hopeless to attempt to visualize or to locate them by means of only 1 or 2 c.c. of radiopaque oil; such a small amount can easily trickle past the lesion without producing any significant change in contour.

In making lipiodol studies in cases of intractable sciatic pain the lumbar injection of the oil is preferred. After the injection, the patient is placed in a sitting position for a few minutes to allow the oil to descend into the sacral region. Later, on the fluoroscopic table in the prone position, the oil is observed as it flows cephalad under the fluoroscope. In this way defects can be observed, and several roentgenograms should be made immediately. Fluoroscopic examination should also include observations in the prone, oblique, and lateral positions in order to verify the level of the lesion as well as aid in establishing its location to one side or the other. In addition to the outline of the defect, produced by the mass of the protruded disc, significant changes in the shadows of the nerve root may be present at the level of the lesion. These consist of edema of one or more nerve roots which may be localized by broadening of the negative shadow of the nerve root. The surgeon sometimes has difficulty at the operating table in associating the pathologic changes found with the roentgenologic shadows, but Hampton and Robinson have offered a solution for this by calling attention to the fact that the fifth lumbar root and most of the first sacral root are extradural at the lumbosacral junction; for this reason a lesion compressing either of these roots may produce a minimal defect in a contiguous subarachnoid space.

Another condition which may contribute to intractable sciatic pain and which may or may not be associated with protruded intervertebral disc is thickening of the ligamentum flavum. This was first emphasized by Towne and Reichert in 1931. They reported two cases in which there was compression of the cauda equina; at operation, hypertrophy of the ligamentum flavum was removed, with complete relief of clinical symptoms. The ligamenta flava stretch across the posterolateral aspect of the spinal canal between the laminae. These ligaments, which are made up of yellow elastic fibers, are attached to the anterior aspect of the superior laminae and to the posterior aspect of the inferior laminae. The two ligaments of each interlaminar space fuse in the midline and extend laterally to form the posterior margin of the intervertebral foramina. Hypertrophy of these ligaments, either due to inflammation or trauma, narrows the intervertebral canal and may constrict the nerves of the cauda equina or compress the nerve roots opposite the segment. It is evident, therefore, that in the presence of a protruded intervertebral disc any hypertrophy of a ligamentum flavum would increase the symptoms proportionately.

Since the original report, Spurling, Mayfield and Rogers, and Abbott, have called attention to this pathologic condition which can produce intractable pain and other associated clinical evidence of compression of the spinal nerve roots. In the roentgenologic examination following injection of radiopaque oil in the subarachnoid space, hypertrophy of the ligamenta flava becomes evident in narrowing the canal, and this in some cases produces shadows which, according to Camp,[4] are pathognomonic. These lesions are mentioned in passing as contributing to the cause of intractable pain because, at operation, such lesions are removed with the discs, relieving pressure on the nerve roots.

In respect to the diagnosis of protruded intervertebral disc as a cause of intractable sciatic pain, it is evident that no definite clinical syndrome is produced. In an effort to discover a clinical syndrome which would be of diagnostic importance, Walsh and Love recently reviewed a series of 100 cases proved by comprehensive general and neurologic examination and at operation to be protruded intervertebral disc. Some very interesting data were brought out: Protruded intervertebral discs may occur in the cervical, thoracic, or lumbar regions, but the majority occurs in the lumbar region and almost 50 per cent occur at the lumbosacral junction. Walsh and Love found that the majority of protruded intervertebral discs occurs in males (there were seventy-seven males and twenty-three females in their series) and that these lesions occurred predominantly in the fourth decade, the average age of the patients being 40 years, the youngest being 16 and the oldest 77. Of these 100 protruded intervertebral discs, eighty-eight were in the lumbar region. In view of the fact that these are the cases we are most interested in with regard to intractable sciatic pain it was interesting to note that 94 per cent of the patients suffering from protruded lumbar discs complained of sciatic pain. It was also interesting to note that in 83 per cent of these cases there was a history of injury. While continuous and persistent sciatic pain is encountered frequently, in 86 per cent of these cases the pain was intermittent. In addition to the sciatic pain, which was present in 94 per cent of the cases, there was an associated low back pain in 55 per cent which had preceded the appearance of the sciatic pain. In 2 per cent there was an associated femoral extension of the pain.

In cases of tumor of the spinal cord the majority of patients complain of night pain; they are awakened and the pain is relieved by moving about or when they sleep for the rest of the night in a chair. In 31 per cent of these cases of protruded intervertebral disc night pain was present. Another characteristic of the pain of tumor of the spinal cord is its accentuation on coughing, sneezing, or straining; in 39 per

cent of the cases of lumbar protruded intervertebral disc this was also true. In addition to intractable pain, there was paraplegia in 40 per cent of the cases and sphincteric incontinence in 8 per cent.

In attempting to augment the history in determining a characteristic syndrome, the neurologic findings in these eighty-eight cases of protruded lumbar intervertebral discs were interesting. There was a positive Lasègue sign or increase in pain on stretching of the sciatic nerve in 82 per cent of the cases. There was sciatic tenderness in 63 per cent. The Achilles reflex was diminished or absent in 56 per cent of the cases and the hamstring reflexes were diminished or absent in 27 per cent. The patellar reflexes were diminished or absent in only 9 per cent. There was muscular paresis in 26 per cent, muscular atrophy in 9 per cent, and sensory loss in 31 per cent; in only 3 per cent was the neurologic examination objectively negative. However, the examination was negative except for positive Lasègue signs of sciatic tenderness in 16 per cent of the cases. The average duration of symptoms was six years, the shortest duration being one month, the longest thirty-two years. The average duration of low back pain before the development of sciatic pain averaged four years. The cerebrospinal fluid was examined in these eighty-eight cases in an effort to establish the basis for the differential diagnosis, and the determination of total protein seemed to be the only outstanding factor. Total protein was estimated in only eighty-four cases; in 81 per cent of these cases it averaged 40 mg. per 100 c.c. or more, the highest value being 240 mg. In 19 per cent of the cases the total protein averaged less than 40 mg., the lowest value being 20 mg. per 100 c.c.

On analyzing the results of the clinical investigative study in these cases of protruded intervertebral disc, a careful examination elicited evidence of nerve involvement, as indicated by the positive Lasègue sign, sciatic tenderness, reflex changes, paresis, atrophy, or sensory loss in 97 per cent of the cases, the examination being objectively negative in only 3 per cent. The increase in the total protein of the spinal fluid in 81 per cent of the cases indicates that this is a valuable clinical finding.

The treatment of intractable sciatic pain due to protruded intervertebral disc compressing the nerves or nerve roots is surgical in all cases. Temporary and palliative relief may be obtained by conservative orthopedic treatment such as extension, support by means of sacro-iliac belts and braces, and fusion, but unfortunately the relief is only temporary and the irritation of the nerve roots recurs. It is conceivable that in some cases facetectomy, as suggested by Ghormley,[10] would decrease irritation to the nerve root and result in relief. The tendency for the protruded disc to increase in size, however, and the possibility of some hypertrophy of the overlying ligamentum flavum, indicates that the treatment of choice consists of laminectomy with removal of the protruded disc.

Once having localized the lesion by means of fluoroscopic examination and by subsequent roentgenographic examinations with radiopaque oil, a small laminectomy, involving only two spines and laminae, is all that is necessary in the majority of cases. The anesthetic of choice is ether, and it is best administered by the open drop method over the end of a Magill intratracheal tube which has been introduced after the patient has been anesthetized by nitrous oxide and oxygen. After the patient has been anesthetized, he is placed prone on the operating table in such a manner that the prominence of the lumbar and sacral spinous processes is increased. Through a vertical incision, subperiosteal resection of the spinous processes and laminae is carried out. The extent of the laminectomy depends a great deal, of course, upon the location of the protruded disc. In cases in which the protrusion is unilateral it may be necessary to remove the articular facets on that side. The protruded disc may be removed extradurally or transdurally, and again it depends a great deal upon the ease

of exposure whether the dura is retracted to expose the protruded disc or is incised and the disc approached intradurally. Protrusions of the disc can be palpated and the exposure carried out as indicated. When the protrusion has been exposed by retracting the dura mater, the thinned out posterior longitudinal ligament is incised either longitudinally or by means of a crucial incision.

Protrusions may be of two kinds, in that the posterior longitudinal ligament may be so thin that the protruded disc pops into the wound, or the disc being fibrous and adherent, it may have to be curetted from its bed. All protruding tissue that is causing or could cause pressure on the nerve roots or spinal cord should be removed. One of the outstanding features encountered at the operating table is the evidence of irritation on the adjacent nerve roots. They are increased in size and edematous and sometimes are injected, showing that the intractable pain has been caused by irritation of the protruded disc. Following removal of the disc the lipiodol is removed and the wound is closed; usually a Penrose drain is left in place from twenty-four to forty-eight hours. Patients are kept in bed following operation for from ten to fourteen days and, if voluntary urination does not occur by the third day, an inlying urethral catheter is placed for continuous drainage.

The postoperative results in all cases of intractable sciatic pain have been most gratifying. The mortality also is gratifying, there having been no deaths in the entire series. In the literature there are reports of operative cases of protruded intervertebral discs in which fusions have been necessary to relieve subsequent postoperative pain. In none of our cases has this been true.

SUMMARY

Intractable sciatic pain which is persistent, intermittent, and does not respond satisfactorily to any type of treatment should be suspected as being due to a protruded intervertebral disc. In a large percentage of cases a careful and complete examination will elicit certain evidences of underlying pathologic change, although it may be necessary to localize and identify the lesion by means of roentgenologic examinations following the injection of radiopaque oil within the subarachnoid space. The presence of increased protein in the cerebrospinal fluid and the positive Lasègue sign, changes in reflexes, and tenderness in the sciatic nerve, are helpful although not essential in making the diagnosis.

The treatment of choice is laminectomy, with removal of the protruded intervertebral disk as well as a possible associated hypertrophied ligamentum flavum. There were no deaths in a series of 100 cases.

Postoperatively, the patient should be cautioned not to return to work too soon, and for a long period of time no heavy labor should be attempted. As a group the patients suffering from intractable sciatic pain caused by protruded intervertebral discs are permanently relieved of their pain and disability.

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The gravity of a head injury depends on the degree of damage to the brain. While it is important to know whether or not the skull has been fractured, it is far more essential to ascertain how severely the brain has been injured.

From—"A Textbook of Surgery" edited by Frederick Christopher (Saunders).

PIGMENTED NEVI

WITH SPECIAL REFERENCE TO THEIR SURGICAL TREATMENT

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LARGE nevi and hairy moles are skin blemishes which are particularly conspicuous when located on the face. They then present a difficult dermatologic problem.

Pathologically they represent a circumscribed increase of skin pigment, often associated with hypertrophy of one or all the cutaneous structures, especially connective tissue and hair.

As a rule, once established they remain permanent, with no tendency to reduction in size. There is often a disposition to an increased growth of hair. The blemish is benign unless constantly irritated, when degenerative changes may set in.

Treatment. When small, the benign growth is easily destroyed by desiccation or by means of a keratolytic substance (trichloracetic acid, etc.). This procedure is inadvisable for flat nevi, even of small size, as it necessarily produces a depressed scar. Excision with fine approximation results in a linear scar which is generally less conspicuous than a round depressed one.

In large nevi, use of the electric needle or a keratolytic substance is contraindicated because of the long time such treatment requires and the conspicuous scarring which is inevitably produced. The disfiguring scar usually requires reparative surgery at a later date. Besides, repeated prolonged treatment is extremely difficult, if not possible, in small children, who represent the majority of these cases.

Radiation therapy has been advocated in the treatment of pigmented nevi. The ease with which it can be applied is responsible for abuses in its use. Authoritative opinion on this matter is clearly expressed by McKee,[1] who states that "*X*-rays and radium are not indicated in the treatment of naevus pigmentosus. The author tried beta and gamma rays without result."

A B

FIG. 1. A, depressed, irregular scar with atrophy of cheek in girl of fifteen, following application of radium for nevus in early infancy. B, condition after repeated partial excision of scar with free full-thickness graft from upper lid to upper end of defect. Subcutaneous insertion of a dermo-fat graft (from abdomen) to raise depressed cheek.

Plastic Repair. Proper mental hygiene requires that all those affected by this extensive skin blemish should be treated at an early age. Replacement of the involved skin areas by plastic procedures is the most effective means of repair.

Excision of the circumscribed nevus is the simplest method available. Wide undermining of the surrounding skin is sometimes necessary to bring about closure without undue tension. If necessary, repeated partial excisions can be undertaken. If necessary, repeated partial excisions can be undertaken. After each excision the area of involvement is reduced, aided by the natural elasticity of the skin; repeated excisions finally eradicate the deformity.[2] (Fig. 1.)

This procedure cannot be applied when a large nevus is located in the vicinity of facial cavities, such as the orbit, mouth or

A B

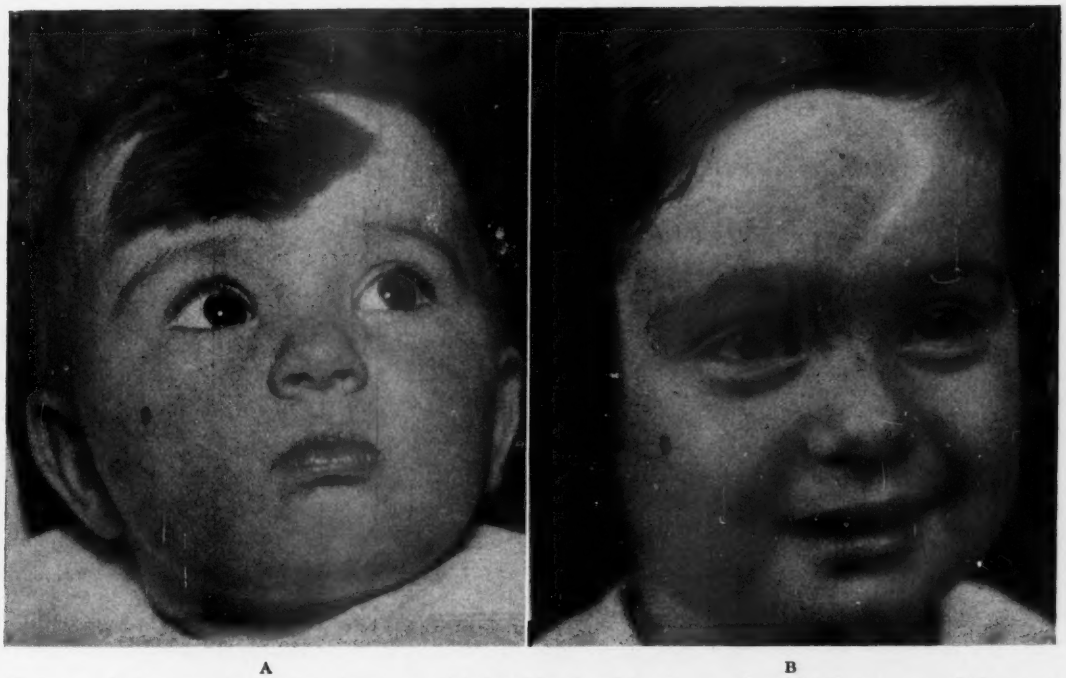
FIG. 2. This case is shown to demonstrate the possibility of eradication of any extensive facial skin deformity by utilizing the procedure of rotating adjoining skin flaps. This applies as well to nevi as to any type of skin involvement. A, third degree burn of right cheek, temple, upper and lower eyelids in 24 year old girl. Burn caused by fall on radiator. B, defect of cheek and temple was repaired by rotating flaps from forehead and cheek after same were delayed in order to increase their blood supply. Linear scars in photograph (taken five weeks after surgery) outline forehead, cheek and temporal flaps which were brought together following wide undermining. The partial loss of both lids was repaired by grafting of free retroauricular skin.

A B C

FIG. 3. A, hairy pigmented nevus in a 5-year old child, involving part of cheek and extending on side of nose and lower eyelid. Reduction in size of nevus by partial excision in horizontal and vertical diameters was done in first stage, making it possible later on to transfer a smaller forehead flap. B, shows forehead flap transferred to cheek with pedicle still attached. C, condition after return of pedicle to forehead and prior to final removal of linear scars.

A B

Fig. 4. A, pigmented atrophic scar of upper two-thirds of nasal wall in girl of sixteen, following radium treatment for nevus in early childhood. B, following excision of scar, defect repaired with a free full thickness retroauricular graft. Color of graft one year after operation, perfectly matches surrounding skin. Plastic repair done in early childhood would have eliminated a conspicuous blemish lasting for sixteen years.



A B

Fig. 5. A, hair nevus involving about two-thirds of forehead in six months old infant. B, condition one year later, following excision of nevus and transplantation of a free full thickness abdominal graft. Color and texture of graft were steadily improving and at present, about three years after surgery, the grafted skin matches the surrounding area. The slightly depressed scar around graft will be excised later.

nostrils. Excision in these locations, followed by closure, would necessarily bring about distortion of the part. To prevent this, rotation of the surrounding skin must be attempted. The range of possibilities provided by shifting and rotating the skin is extensive. Often, prior to rotation, if long skin flaps are to be used, it is advisable to delay the skin in a preliminary stage (by raising and resuturing in place) in order to increase the blood supply. By shifting and rotation of the delayed facial skin, we are often able to cover extensive defects of the face which seem impossible of repair without free skin grafting. (Fig. 2.)

The advantages of this procedure are self-evident: the rotated adjoining skin matches the texture and color of the face. This is not always the case even with the most successful free skin grafting, especially when large areas are involved.

The forehead provides the best matching skin for the face. (Fig. 3.) The use of forehead skin can be combined with partial repeated excisions, without causing distortion. As the forehead skin is transferred on a pedicle, this procedure entails numerous stages. Where the amount of skin required is not too extensive, selected free grafts suitable for the face are often used with success.

Free Grafts. Full consideration should be given to their texture and color. The thin dermo-epidermic grafts (Thiersch, split or razor graft) are as a rule inferior in color and texture to the full thickness grafts. They are therefore contraindicated as a rule in most facial repair except as a temporary procedure, for instance, after the removal of malignancies when final repair is delayed.

Full thickness grafts have their own special indications. The best qualified among them are those taken from the upper lids or behind the ears. (Fig. 4.) They are the closest match to the normal facial skin. Next in order of preference are the skin grafts from the neck, inner arm and abdomen. This, of course, may vary in the individual and exceptions to the rule are frequent. In the larger skin defects it is often possible to accomplish the repair by the use of grafts from both eyelids and both ears. When scarring on the arm is to be avoided, as in young women, an abdominal free graft is given preference. (Fig. 5.)

The behavior of free grafts varies in each individual. As a rule the color and general appearance improve with time.

SUMMARY

Treatment of extensive birthmarks should be undertaken in early life.

The use of electric needle or keratolytic substances is indicated only in small raised nevi.

The use of *x*-rays and radium is contraindicated.

Whenever possible, a large skin blemish should be eliminated by repeated partial excisions, thereby providing a covering of the same color and texture as the surrounding area.

When complete excision, with or without rotation of the skin, is insufficient, the remainder of the blemish must be replaced by distant skin matching the face as closely as possible.

The forehead, upper eyelid, and behind the ear are the ideal sources of skin.

Thin dermo-epidermic grafts (Thiersch) as a rule do not match the face in texture and color.

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IMPURITIES IN ETHER*

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THERE is a great lack of information both on the occurrence and on the effects of impurities which may occur in ether. Only since 1925 have cases of so-called ether convulsions been reported in the literature. The English have emphasized two factors which have been present in the majority of cases reported: (1) the patients have been young and (2) have had some sepsis at the time of operation.

Many theories have been advanced in an effort to explain the cause of these convulsions. These theories have been reviewed in Sears' report,[1] and also in a recent article by Lundy.[2] In the latter report, the important features of the 137 cases that have appeared in the literature have been tabulated. Lundy added four cases that had been observed by him and his associates. The mortality rate in all reported cases has been 18.9 per cent. As a result of the work done by Rosenow and Tovell, Lundy is inclined to believe that the convulsions are attributable to a neurotoxin or poison produced by streptococci in amounts insufficient to cause spasms in the absence of anesthesia, but which in the course of general anesthesia suffice to incite the muscular spasms characteristic of this condition. He also believes that the convulsions probably can be controlled by the use of barbiturates intravenously.

King[3] reported one case in which the patient died fifty-eight hours after operation. Because of the well known effects of calcium on neuromuscular irritability, calcium gluconate was given by vein. This checked the convulsions temporarily. Rovenstine[4] presented a patient who had had repeated operations with repeated convulsive seizures, but who recovered. He believes that convulsions might in some cases be due to surgical trauma, and thinks it logical to omit the term "ether convulsions," until more definite evidence convicting ether as the etiologic agent is found.

Wilson[5] reported five cases of convulsions. He believes that toxemia and hypoglycemia have a great deal to do with the production of ether convulsions.

Raab[6] observed three cases of convulsions, in two of which recovery occurred. These two received calcium gluconate by vein and the convulsions stopped within a few minutes. Raab believes that alkalosis with subsequent diminution in serum calcium is the real cause.

Woolmer and Taylor[7] reported four patients with convulsions, two of whom recovered. They believe that the heat stroke hypothesis of Dickson Wright may play a large part in the etiology of ether convulsions. The patient's temperature, the temperature of the air and the administration of atropine tend to produce an elevated internal temperature. All of their patients were treated differently, but they recommend cold sponges, the administration of carbon dioxide to accelerate heat loss and evipal by intravenous injection. In addition they use coramine, adrenalin, oxygen and artificial respiration.

Very few studies have been made on these patients. Often time is not available for making any studies, and all efforts are being concentrated on relieving the patient's condition. It is urged that whenever possible accurate clinical and laboratory studies be made and recorded, for in the presence of so many theories a few facts would be indispensable.

* This work was done at the Massachusetts General Hospital, Boston.

Impurities in ether have been incriminated in almost every untoward reaction that has occurred during the administration of this anesthetic. Actual proof for any of these incriminations has never been brought forward. It is only natural to blame the drug for any unusual feature which may happen, but this neither proves nor disproves anything.

A patient whom we personally observed died in convulsions during the administration of nitrous oxide-oxygen, ether anesthetic. We were fortunate in obtaining some blood for examination before the death of this patient. The findings were markedly abnormal and we are at a loss to explain them. However, a more thorough study of these patients should be made whenever possible. By this means some light may be shed on this unusual phenomenon. The case report with the findings are presented.

An 18 year old boy, suffering from obvious intra-abdominal sepsis as a result of a gunshot wound five weeks previously, was admitted from another hospital on September 28, 1934. Transfusion and intravenous fluids were given in preparation for the operation. The preoperative medication consisted of morphine sulfate gr. $\frac{1}{6}$ and atropine sulfate gr. $\frac{1}{100}$, given subcutaneously forty minutes before the anesthetic was started. The anesthetic was nitrous oxide-oxygen induction followed by ether. The total length of the anesthetic was forty-five minutes and the total amount of ether used was 2 ounces. There was no excitement or vomiting during the induction. Muscle twitchings of the face began with the induction, became more severe and more generalized throughout the administration, finally ending with terrific generalized convulsions and death. The respirations were fairly regular and the color pink until about ten minutes before death, at which time cyanosis began. All anesthetics were stopped and 100 per cent oxygen was given, but it had no effect. Sodium phenobarbital gr. 10 and glucose 10 per cent were given intravenously but these efforts had absolutely no effect on the convulsions.

Samples of venous blood were drawn under oil, at the height of the convulsions. These blood samples showed an oxygen content of 6.9 volumes per cent, oxygen capacity of 14.6 volumes per cent, saturation of 47.3 per cent, carbon dioxide content of 61 volumes per cent, and sugar 400 mg. per 100 cc. of blood (intravenous glucose was running into the vein). The ether was analyzed and showed aldehyde present 1:50,000 in two samples. No other impurities were found. Post-mortem examination of the body was done by the coroner but no report was obtained from him. Although 100 per cent oxygen was given for a period of ten minutes the cyanosis became more marked and the convulsions continued. The oxygen content and capacity of the venous blood were very low, with a low saturation per cent. The carbon dioxide content was within normal limits. The blood sugar figures are not reliable because of the intravenous glucose administration.

Excess carbon dioxide, hypoglycemia and lack of preoperative medication have been mentioned as causes of these convulsions. None of these conditions could have been active in this patient. The only positive finding was a low oxygen content of the venous blood despite the administration of 100 per cent oxygen. The reasons for such a state of affairs are not known. Much speculative reasoning could be offered in explanation, but this hardly seems worth while. It is known that convulsions do occur in anoxemic states.

Impurities such as acetaldehyde, peroxides, ethyl sulfide, ketones and alcohol are known to occur in ether. The first three impurities mentioned are said to be toxic if present to the extent of 0.5 per cent or more.[9,10] There is apparently no uniformity of opinion regarding the rate of formation of impurities after a can of ether has been opened. The disposition of partly used cans is always a matter of some doubt. Also when oxygen has been allowed to pass through ether as is done in modern anesthetic machines, the possibility of oxidation with the formation of impurities arises.

With the above facts in mind, we have made some observations on the purity of ether, a product of one of the standard manufacturing companies. Ether was placed in copper containers, in clear glass

bottles and in 5 pound cans as dispensed by the manufacturer. The copper containers were equipped with copper screw caps. The other containers were stoppered with ordinary corks. Each of these containers was thoroughly shaken and a sample of ether pipetted and tested once a week for twelve months. The tests used were as follows:

1. Aldehyde. Nessler's reagent. Ether having aldehyde present 1 part in 80,000 gives a positive reaction.

2. Peroxide. 10 per cent solution of cadmium potassium iodide. Ether having 5/100 of 1 per cent present gives a positive test.

3. Acidity. The sample is evaporated at room temperature. Distilled water is added to the residue. Light blue litmus paper is changed if acid is present.

4. Odor. The sample is allowed to evaporate on a filter paper. Impurities give a perceptible foreign odor as the last portions disappear from the paper.

Further tests were carried out to determine the sensitivity of the methods used. Known solution of impurities in ether were made up as follows: (1) aldehyde, 1 part in 80,000; (2) peroxide, 1 part in 5,000. When the U.S.P. test for aldehyde was used, no reaction was visible in two hours. When Nessler's reagent was used, an immediate yellow color with a heavy sediment occurred within a few minutes. Using the cadmium potassium iodide test for peroxide an immediate yellow color occurred.

The results of these tests are shown in Table 1.

Further tests for impurities in ether were carried out in the following manner: Oxygen was passed through ether in an anesthetic machine at varying rates of flow from 200 c.c. to 500 c.c. per minute for a period of five hours. All tests were negative for impurities on repeated examinations. This procedure was modified so that instead of immediate sampling, the ether was allowed to stand in the anesthetic machine overnight and sampled the following morning. This test was repeated again and again with completely negative results.

CONCLUSIONS

1. A case of fatal convulsions, occurring during nitrous-oxide-oxygen-ether anesthesia is reported.

TABLE I

TEST FOR IMPURITIES IN ETHER

Number	Container	Tests Made	Aldehyde	Peroxide	Acid	Odor
1	Copper	56	Negative	Negative	Negative	Negative
2	Copper	56	Negative	Negative	Negative	Negative
3	Ether can	56	Negative	Negative	Negative	Negative
4	Ether can	56	Negative	Negative	Negative	Negative
5*	Clear glass bottle	56	Positive on 42nd test	Negative	Negative	Negative
6	Clear glass bottle	56	Negative	Negative	Negative	Negative

* After container No. 5 had once become positive, the aldehyde content increased perceptibly during the remaining test periods.

2. Repeated tests for impurities in ether from various types of containers, demonstrates excellent stability. Only one sample showed a positive test, and that after ten months.

3. The passage of oxygen through ether did not produce any impurities, during the period studied.

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The accurate figure of incomplete cures or recurrences [after subtotal thyroidectomy] is difficult to establish, but an approximation of the truth is obtained by Lahey's statement, who found in a follow-up study that, five years after operation, exophthalmos of considerable degree remained in 21.0 per cent of the cases.
From—"The Endocrine Glands" by Max A. Goldzieher (Appleton-Century).

PHYSIOLOGIC ABDOMINAL INCISIONS

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IT is not the closing of an incision which causes adhesions, herniae, and evisceration; it is the opening. Regardless of whether one uses silk, wire, or gut, one cannot repair damage which has been too great. There is no way by which one can destroy body tissues, replace them immediately with mechanical substitutes and expect those tissues to function. Those who look to these mechanical aids in closing incisions are looking only at the result. If they would look at the cause they would then be able to set about constructively seeking a real method of eliminating postoperative wound ruptures. The cause of ineffective closure is obvious. It is the incision.

White[24] says: "In the symposium mentioned, and the discussion which followed, stress was placed upon the suture material, the method of closing the wound; reference was made to infection, the cachectic condition of the patient, the pulmonary complications and other indeterminate factors, but very little was said of the type of the incision and the disturbance of the innervation of the muscles involved in the hernia." Our own experience has convinced us of the importance of maintaining nerve supply. The blood supply is of lesser importance because of the greater power of regeneration of the circulatory system.

Cave[3] says: "It seems reasonable to presume that though considerable time and concentration are utilized in the performance of the operation within the abdomen, often a two hurried and careless closure is effected by a weary operator or an inexperienced assistant." Cave found that in eleven years at Roosevelt Hospital 6.02 per cent of all herniae were incisional, 2.2 per cent of incisional herniae occurring in 5,366 abdominal operations. Cave reports 444 patients operated on through a McBurney incision for acute appendicitis. In 282 cases not drained no incisional hernia occurred. In the remaining 162 cases, which were drained, twenty-one incisional herniae developed. Obviously these herniae are attributable to the fact that drains were used, not to the incision.

Fallis[7] has published a report on fifty eviscerations from a series of 7,903 consecutive laparotomies. In considering forty-nine of these cases he finds that twenty-six ruptures occurred in upper abdominal incisions. It is interesting to note that all of the incisional ruptures occurred in the use of various unphysiologic incisions while none occurred with the use of the Pfannenstiel or McBurney incisions, the only two physiologic incisions listed. While Fallis draws attention to the fact that no ruptures occurred after the use of the McBurney, he dismisses the Pfannenstiel as "infrequently used."

Bettman and Lichtenstein[1] reported thirty-two cases of evisceration in 1936. In compiling their figures they eliminated 5,000 appendectomies which were done through a McBurney incision because "many authors felt it is not conducive to evisceration." They also state, "We did not feel that the method of wound closure made a great deal of difference for almost as many types of sutures and methods of closure are used in the Michael Reese Hospital as there are surgeons working."

Heineck[9] has said, "The abdominal wall acts as a buttress for the abdominal viscera. It assists in regulation of intra-abdominal pressure; it aids in processes of respiration, urination, defecation and parturition. All incisions of the abdominal

wall weaken it, impair its integrity and predispose to hernia formation." While Heineck does call attention to the fact that incisions should be no longer than necessary, he stresses the prevention of incisional herniae by minimum traumatism, perfect hemostasis and asepsis, the use of absorbable suture material, careful closure and minimum drainage—he makes no comment upon the use of physiologically correct incisions except the McBurney.

Starr and Nason[23] of Boston give 0.61 per cent of definite evisceration in 2,455 abdominal operations. On none of these patients was a physiologically correct incision used.

Seventy-five per cent of the cases of evisceration reported in a survey to McCauliff[14] occurred after a midrectus incision. Transrectus and midline incisions accounted for most of the remaining 25 per cent. Nearly all occurred above the umbilicus. No occurrence was recorded in any report where muscle sliding or muscle retracting incisions were used.

Shipley[19] asks, "What can be done to lessen the percentage of broken down infected abdominal incisions?" Speaking about abdominal operations he says, "The final step is one about which there is lack of agreement, much anxiety, and no little grief—the method of closure. Many different materials are used. No single way of suturing the wound edges has been proved satisfactory. The problem calls urgently for solution."

There is a striking incompleteness about most of the papers on this subject. Classification is confused. Postoperative wound rupture is a term constantly used. It may mean anything from a simple drain hernia to complete evisceration. Many figures have been compiled showing age incidence, seasonal effects, preponderance of sex and other factors. Many times mention of the type and length of incision used is omitted; generally the remote results are disregarded. It is not reasonable to evaluate the detrimental results of unphysiologic incisions in terms of evisceration alone. Figures from a number of reports indicate the prevalence of evisceration to be about 0.6 per cent and the mortality among these cases is from 35 to 70 per cent.

The more remote results are the postoperative herniae (those in which evisceration does not occur). The incisional hernia occurs up to twenty years after operation, but the responsibility must still be laid on the original incision. Masson[16] reviewed 5,502 cases of hernia treated at the Mayo Clinic and found 10.8 per cent of them to be incisional. I have seen too many patients whose original gall-bladder operation occasioned as many as four subsequent operations in an effort to repair the incisional hernia. The total number of patients who have a postoperative incisional hernia cannot be determined one month, six months, or even six years after operation. While most of these herniae appear soon after operation, an appreciable number occur many years following. Particularly is this true in those cases in which drains are not left. In our experience over 85 per cent of the incisional herniae which follow vertical incisions without drainage occur during the sixth to the tenth year following operation. In 128 patients of ours[20] with no external evidence of hernia five or more years after operation through a vertical incision, only nine were found to have a satisfactory union of the posterior sheath.

The high incidence of postoperative adhesions to the inner side of the scar is of great importance. In a series of 367 of our cases operated upon five or more years previously through vertical incisions there were only five who did not have adhesions to the under side of the scar. Some factor other than imperfect closure must be responsible for this high incidence, for many patients have strong, apparently perfect scars, but with massive adhesions under them.

No amount of research on suture materials, duration of operation, age or sex incidence, type or method of suturing, or

method of drainage, is going to eliminate the results of poor incisions. All of these things have importance but the primary

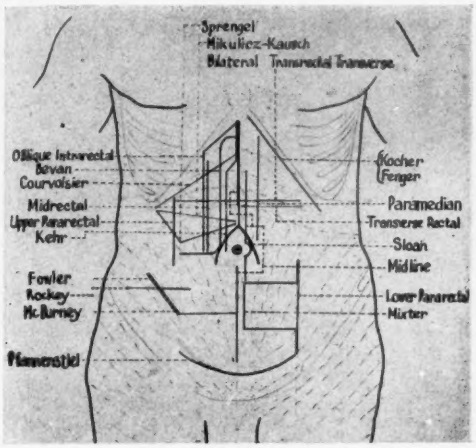

Fig. 1.

factor must be eliminated first. While we know of no way to eliminate the unsatisfactory results by an easier procedure, we can eliminate a very high percentage of these poor results by using physiologic incisions. True, until one is accustomed to their use they seem more difficult. The technique is more complicated and a little more time is required. The marked decrease in the amount of postoperative care and shock offsets the additional time used and the satisfaction of better postoperative results well pays both the surgeon and the patient for the additional time and labor spent.

In deciding which incision to use the surgeon realizes that three requirements should be met, or approached as nearly as possible: the incision should be physiologically correct; it should provide a good operative field; and, the result should be a minimum of disfigurement. Of course, sometimes all of these desirable effects cannot be obtained. Cosmetic result frequently must be sacrificed. However, the only time the physiologic incision should be sacrificed is where speed is essential to save the patient.

With these requirements in mind let us look at the most widely used abdominal incisions. In Figure 1 the various incisions have been reproduced on only one side of the body although most of them are applicable to both sides.

If we are considering these incisions

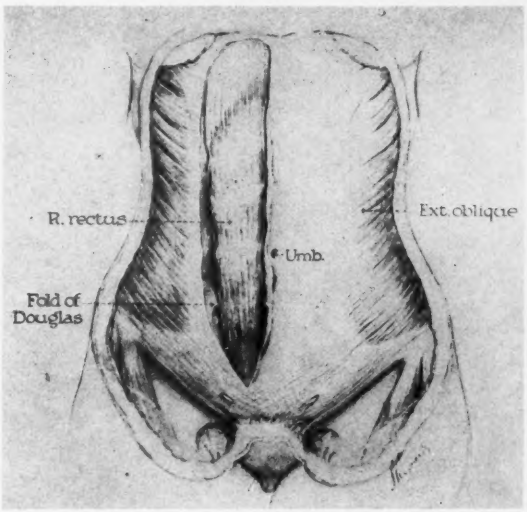

Fig. 2.

with their physiologic correctness in mind we are not particularly concerned with the skin incision except that any incision should be made along the "fissure lines of Langor."

The most important structures encountered in abdominal surgery are the three aponeurotic transverse muscles, the external and internal oblique and the transversus abdominis. The fibers of the aponeuroses of these muscles vary both ways, from the horizontal to 30 degrees. These aponeuroses fuse and form the anterior and posterior sheaths of the recti and in the midline the linea alba. The outermost of these muscles, the external oblique, after its origin from the lateral surfaces of the fifth to the twelfth ribs, becomes a thin flat muscle whose fibers run downward, forward and inward. The posterior portion is attached to the anterior half of the outer lip of the crest of the iliac bone. The balance of the muscle has a broad aponeurosis along its entire medial edge, forming part of the anterior sheath of the rectus. Along an imaginary line drawn between the anterior superior iliac spine and the umbilicus, an aponeurosis runs downward, inward and forward, extending between the anterior superior

iliac spine and the spine and crest of the pubic bone to form the inguinal or Poupart's ligament.

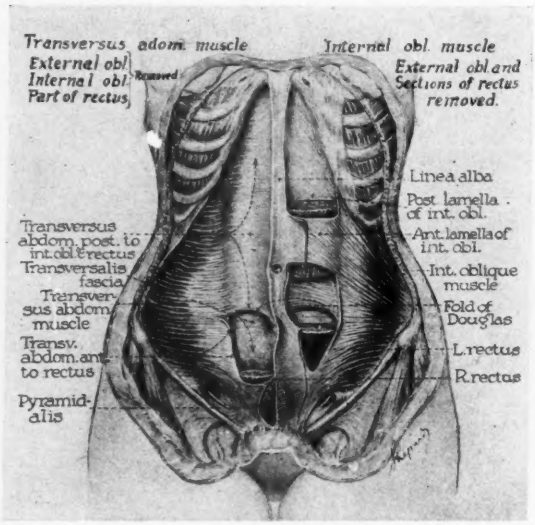

Fig. 3.

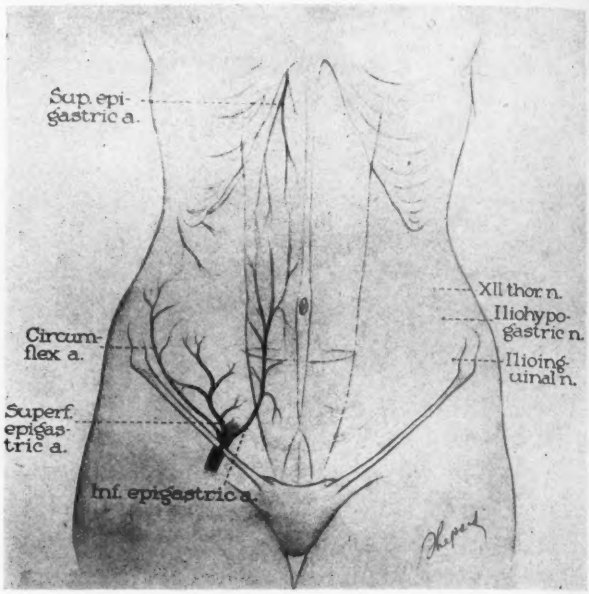

Fig. 4.

The internal oblique, thin and fan-shaped, arises from the lumbodorsal fascia, the anterior two-thirds of the intermediate lip of the iliac crest, and from the lateral half of Poupart's ligament. The fibers run in different directions, forming a wide fan. The posterior fibers run upward and forward to attach to the tenth, eleventh, and twelfth ribs. The remaining fibers extend to the lateral border of the rectus muscle forming an aponeurosis which immediately splits into two layers or lamellae, the anterior of which fuses with the aponeurosis of the external oblique muscle to form the anterior sheath of the rectus. The posterior lamella fuses with the aponeurosis of the transversus abdominis muscle to form the posterior sheath of the rectus.

The transversus abdominis muscle arises: from the posterior surfaces of ribs seven to twelve by six slips which interdigitate with the slips of origin of the diaphragm; from the lumbodorsal fascia; from the anterior two-thirds of the internal lip of the iliac crest; and, from the lateral third of the inguinal ligaments. In the main the fibers run horizontally, perpendicular to the midline. The muscle ends in an aponeurosis which helps the upper three-fourths of the posterior and the lower fourth of the anterior sheaths of the rectus.

The most important surgical consideration in connection with these muscles is the fact that midway between the umbilicus and pubic bone downward the posterior sheath of the rectus is deficient. From this linea semicircularis (semilunar fold of Douglas) downward the posterior lamella of the aponeurosis of the internal oblique and the aponeurosis of the transversus abdominis fuse with the anterior lamella of the internal oblique and the aponeurosis of the external oblique to form the *anterior* sheath of the rectus.

The blood supply of the anterior abdominal wall is derived principally from the superior and inferior epigastric arteries which run the same direction as the recti fibers, and the intercostal arteries which run perpendicular to the recti fibers. All nerves run perpendicular to the recti fibers. The nerve supply is derived from the seventh to twelfth thoracic nerves, from the iliohypogastric and ilio-inguinal branches of the first lumbar nerve. No matter what incision is used the blood

supply is sufficient to compensate cut blood vessels. Nerve damage inflicted by a longitudinal incision, however, cannot be compensated and any muscle or aponeurosis medial to the incision will atrophy. Transverse incision of the abdomen preserves the innervation. Lack of nerve supply and cutting the aponeuroses crosswise of the direction of its fibers are the causes of ventral hernia—and never loss of blood supply. In the midline incision postoperative hernia is due, not to atrophy of muscle, but to cutting the aponeurotic fibers of all transverse muscles perpendicular to the direction of their fibers. Also, the blood supply coming from terminal endings is deficient in the linea alba.

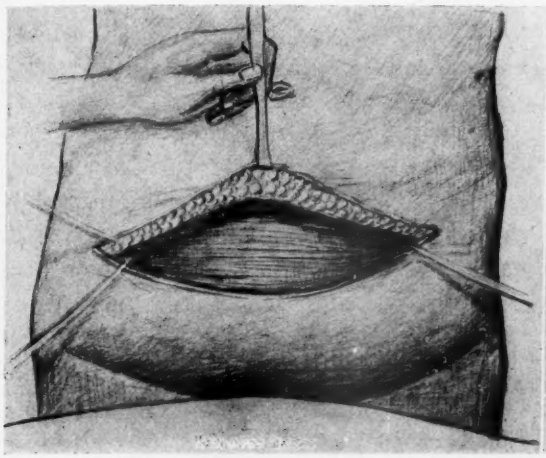

Fig. 5. Skin incision from the two anterior superior spines of the ilium downward in a curve through a point two fingerbreadths above the pubic bone. The flap is pulled up and the anterior sheath exposed.

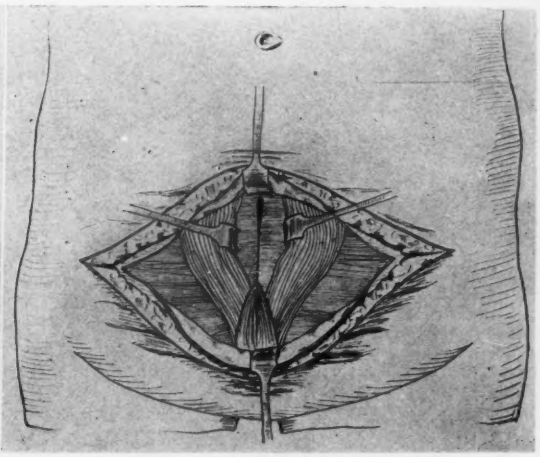

Fig. 6. The anterior sheath of the rectus is split transversely and retracted, exposing the rectus and pyramidalis muscles when found. Wide variation is found in regard to the pyramidalis. Blunt separation and retraction of the recti permits the incision of the fascia and peritoneum longitudinally.

There are six consequences resulting from poor incisions: (1) hernia (which may occur many years after operation) and adhesions; (2) difficulty in closing abdomen; (3) postoperative pneumonia due to tension making the patient afraid to cough; (4) longer confinement in bed; (5) poor cosmetic scar; (6) evisceration under increased abdominal pressure. Which tissues in the abdominal wall are physiologically the most important from the viewpoint of prevention of adhesions or hernia? Adhesions are caused by imperfect closure of the peritoneum or by failure of the closure to hold. While it is rupture of the peritoneum which causes the adhesions, it is the lack of restraining pressure on the part of the aponeurosis and fascia forming the posterior sheath of the rectus which enables the peritoneum to open. We may conclude, then, that the most important tissue of the abdominal wall, physiologically, is the aponeurosis forming the posterior sheath, and the transversalis fascia. Following are, in the order of their importance, the peritoneum, the rectus muscle, the anterior sheaths of the rectus and the deep and superficial fascia.

In the upper abdomen the transversalis fascia is a thin layer surrounding the entire abdominal cavity although known by different names in different areas. The layer is elastic and its fibers are circular and always perpendicular to the longitudinal axis of the body. As far as the surgeon is concerned it may be considered as one layer with the peritoneum in the lower abdomen and with the peritoneum and posterior sheath in the upper abdomen and is treated as such. For this reason the posterior aponeurosis and the fascia are the main hernia preventing factors in upper abdominal work while the

anterior aponeurosis is the restraining unit in the lower one-fourth.

If we keep in mind the anatomy of the abdominal wall and the direction of the fibers in its tissues, it is evident that no longitudinal incision through this fascia can be physiologic. If we recognize the importance of cutting as little as possible of the nerve and blood supplies, and not cutting aponeuroses crosswise, we leave as truly physiologic incisions only those which involve muscle-splitting.

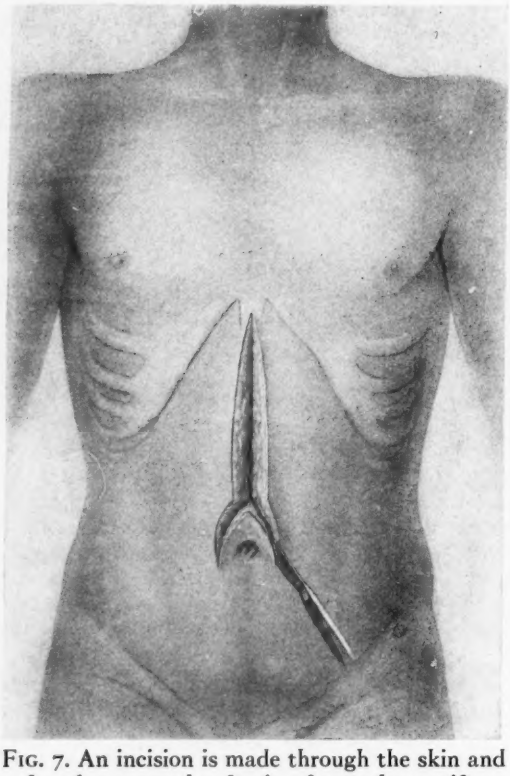

FIG. 7. An incision is made through the skin and fat down to the fascia, from the ensiform process to a point 3 cm. above the umbilicus and continued outward and downward on each side of the umbilicus to a point 4 cm. below the umbilicus on either side, leaving a V-shaped piece of skin and fat around the umbilicus.

It is, of course, impossible to perform all surgery through muscle-splitting incisions. Our efforts must be bent toward the nearest approach to this ideal, at the same time retaining the maximum degree of utility from the standpoint of operative field, speed of operation and accessibility.

In a short paper it is impossible to discuss the many incisions which have been advocated for abdominal work. The surgeon who desires further information about any of these incisions may find a most complete chapter on them in Spivack's book.[22]

The difference, externally, between the physiologic and unphysiologic incision is apparent long after their use. The unphysiologic incision often produces a broad scar which very evidently is the result of any undue strain placed upon it. In our experience we have usually found upon reoperation that these broad scars from unphysiologic incisions have adhesions under them which have resulted from an improperly closed peritoneum or the giving away of sutures in the innermost layers before union has taken place.

Over 90 per cent of all surgery in our clinic is done through one of three incisions: a modified McBurney, the Pfannenstiel, and the Sloan. These incisions are nearly perfect physiologically and produce the best results, we believe.

The advantage of the McBurney "gridiron" incision is that it is more nearly perfect, physiologically, than any other. Placing the incision just inside the iliac spine permits direct access to the mesoappendix without displacing loops of the small intestine mesially or rotating the head of the cecum. While some surgeons do not use it, claiming that it is slower and that it is difficult to remove an appendix which is tied down by adhesions retrocecally, the surgeon accustomed to its use finds no difficulty in severing the tied-off appendix at the colon and then bringing it out proximal end first. This is simplified by the modified incision. It is, perhaps, a slower procedure but well worth the additional time, being paid for by the rapid recovery and the certainty of no postoperative hernia. Most important in the case of rupture, the abscess is walled off by the omentum into the lower right quadrant, facilitating drainage while leaving the infection localized. The only possible disadvantage of this incision is that the appendiceal region and that of

the right ovary are the only ones which may be reached. It is our practice upon entering the abdomen with the McBurney

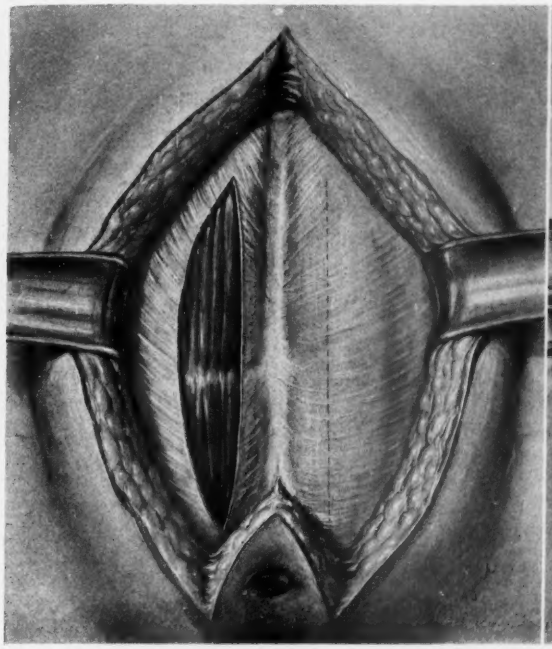

Fig. 8. After palpation of the edge of the rectus by the finger, vertical incisions are made through the anterior sheaths of the recti about 1 cm. distal from the mesial edge of the recti. Upon the length of these two incisions will depend the amount of exposure that it is possible to obtain.

and discovering the need for more extensive surgery or additional room, to extend the skin incision downward laterally, joining the McBurney to a Pfannenstiel. By doing this we are enabled, when necessary or advisable and without any detrimental effect on the patient, to do any additional work necessary in the lower abdomen and still maintain a physiologic incision. If preferred, the Fowler or Weir extension incision can be used. In this incision the rectus is retracted medially and the anterior sheath, peritoneum and transversalis fascia are incised transversely to the midline from the lower end of the McBurney.

For all lower abdominal surgery (except those cases of large tumors or extensive exploratory) the Pfannenstiel[18] incision offers a practical and nearly physiologic solution. If we remember that the aponeuroses of the transversus abdominis and internal oblique, in the lower quarter of the abdomen, are part of the anterior

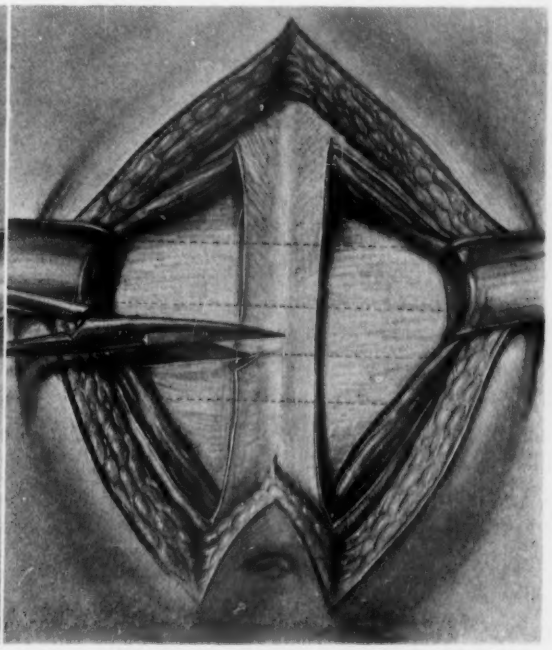

Fig. 9. After retractors are in place and the posterior sheath of the rectus exposed a transverse incision is made through the exposed posterior reflexion of the sheath of the rectus and the peritoneum. Dotted lines indicate locations which may be chosen.

sheath, then we can realize that the longitudinal incision through fascia and peritoneum is not so serious as long as we still make the transverse incision (parallel to the fibers) through the aponeurosis which is the anterior sheath.

The Pfannenstiel incision is an old one which fell into disuse. It was one of the earliest forerunners of physiologic incisions. The incidence of postoperative hernia and adhesions is almost negligible; its application is wide and affords ample field for ordinary surgery. The scar is not disfiguring and the closure is easy.

The Pfannenstiel has several disadvantages. It cannot be extended sufficiently for removal of unusually large tumors; however, these are usually located by palpation and in those instances another incision used. It is harder to work through the Pfannenstiel than some other incisions and the technique is more extensive. In

our experience these disadvantages are far outweighed by the superior result obtained.

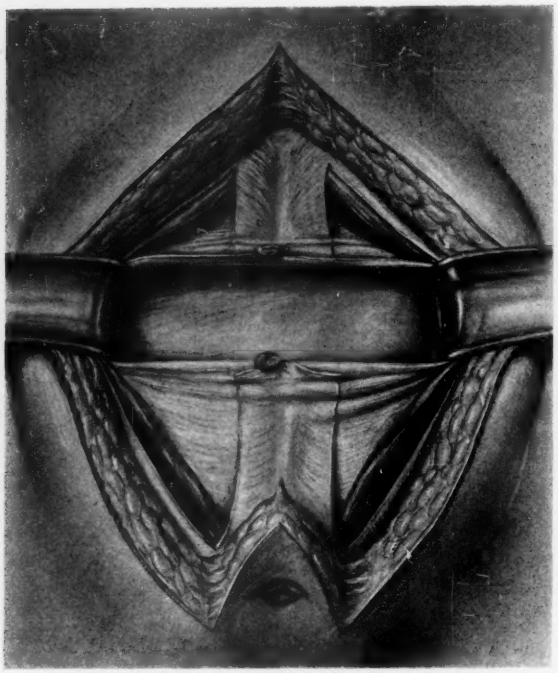

FIG. 10. The incision is extended across the linea alba parallel to the direction of the fibers of the aponeuroses from the outer edge of one rectus muscle to the outer edge of the other.

The application of the Pfannenstiel incision is shown in Figures 5 and 6. The skin is incised from the two anterior-superior spines of the ilium downward in a curve through a point two finger-breadths above the public bone. The flap is pulled up and the anterior sheath is exposed. The anterior sheath of the rectus is split transversely and retracted, exposing the rectus and pyramidalis muscles when found. Wide variation is found in regard to the pyramidalis; sometimes it is particularly large and well developed, at other times it is entirely missing. Blunt separation and retraction of the recti permits the incision of the fascia and peritoneum longitudinally.

In the event that this opening is too small for removal of the uterus or large tumors a vertical incision of the anterior sheath may be extended from the lowest point of its arch downward almost to the symphysis pubis. This permits two small triangle flaps to fold back. The anterior sheath can be further retracted as may the recti, and the incision through the transversalis fascia and peritoneum is extended downward. If the pyramidalis muscles are present and at all well developed the vertical extension must be extended along the lateral edge of one of them and the pyramidalis retracted on one side along with the rectus on that side.

The question has been brought up that the extension of the Pfannenstiel downward to the symphysis pubis is unphysiologic. This is quite true. However, this small unphysiologic part of the incision is at the lower apex of all the abdominal muscles at a point where the distance of extension and flexion from intra-abdominal pressure is slight. We have never found an incisional hernia following this procedure unless a drain is used.

The Sloan[21] incision is a modification of the old Winkleman incision which was used in Europe many years ago. Since it was first shown in 1927 a number of men in this country have started using it. These have quickly extended its use. To others it has seemed a formidable process with a very difficult technique. In our own experience, however, this incision has been extremely successful both surgically and postoperatively. Its technique is completely illustrated and explained in Figures 7 to 18 inclusive.

This is a fast, simple and adequate incision for most work. Only one opening need be made in the anterior sheath; the posterior sheath, fascia and peritoneum are opened transversely by blunt dissection. At the same time, should it prove desirable, the skin opening may be extended on the other side, another incision made in the anterior sheath and the linea alba cut transversely, forming the full incision. (Fig. 19.)

Spivack[22] advances as the only objection to the Sloan incision, the fact that the anterior sheath of the rectus is cut longitudinally. This fact prevents the incision

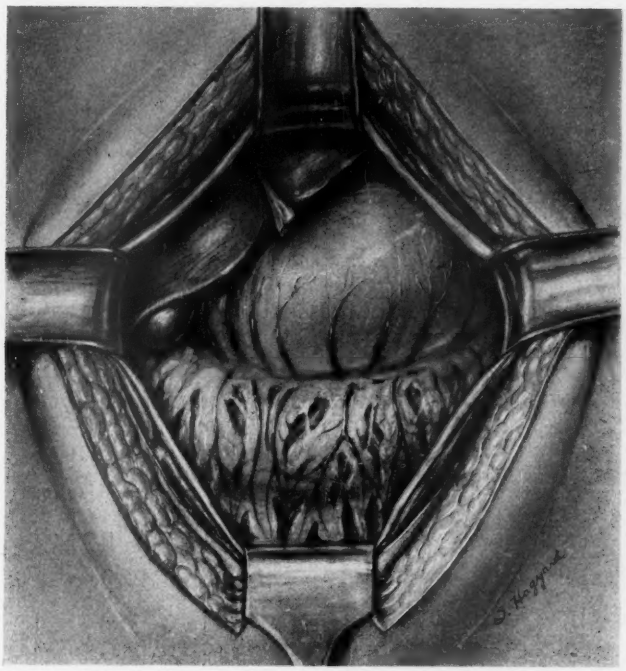

Fig. 11. Retraction upward and downward affords an opening with a diameter about equal to the length of the incisions in the anterior sheaths of the rectus muscles.

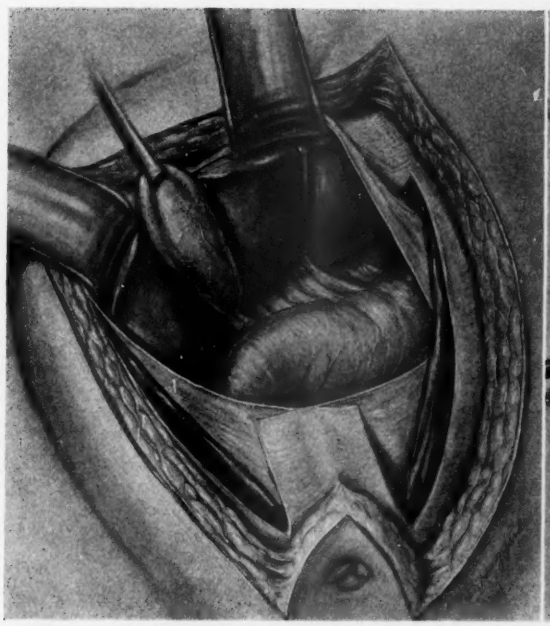

Fig. 12. Retraction upward and outward affords access to the gall-bladder region. The opening can be retracted over the regions of the spleen or appendix also.

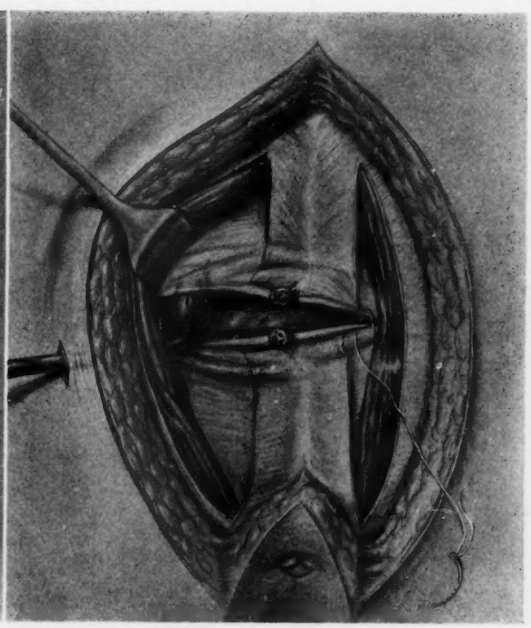

Fig. 13. In cholecystotomy the drainage tube is brought out through a puncture wound and the gall-bladder is brought to the abdominal wall at any point desired.

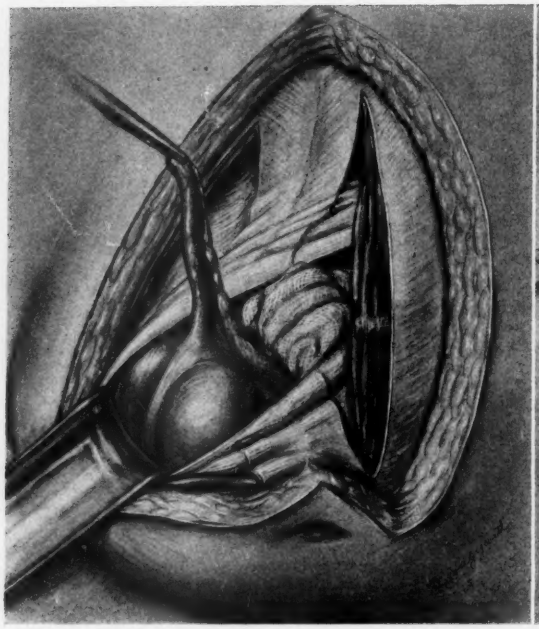

FIG. 14. The appendix is more readily dealt with through this incision than through a high right rectus incision of any reasonable length.

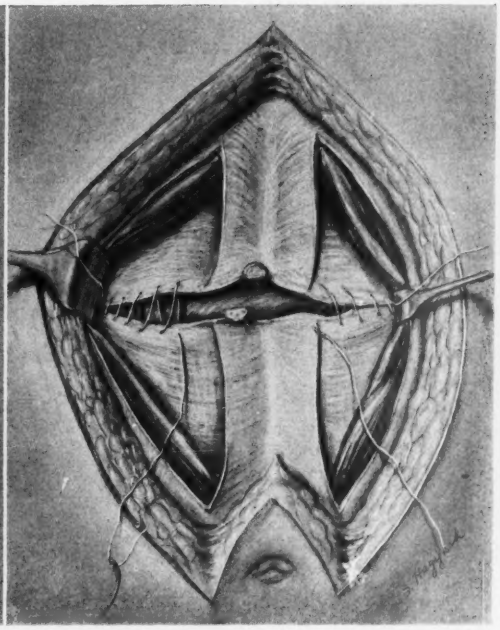

FIG. 15. The closure of the peritoneum and posterior layer of aponeurosis is begun at the outer ends of the transverse incision.

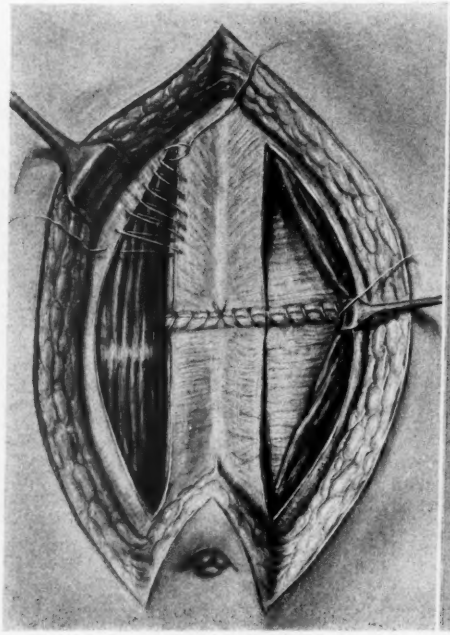

FIG. 16. No difficulty is experienced in closing the abdomen even with the largest and fleshiest patient as no tension whatever is required to bring the edges together.

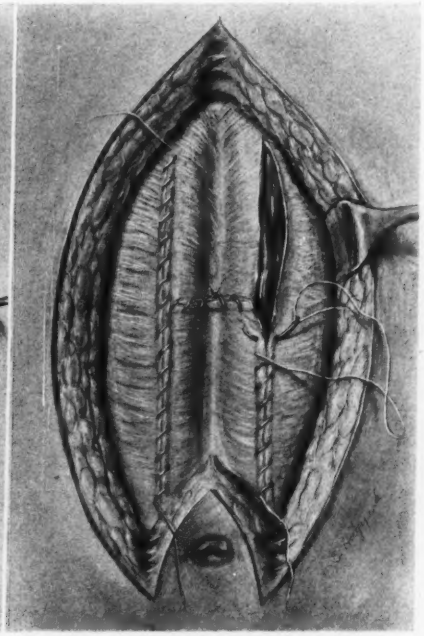

FIG. 17. No appreciable tension upon the sutures required to close the anterior sheath.

from being perfect physiologically, but we must remember that the anterior sheath bears very little strain. If the posterior sheath is intact, there is practically no strain upon the sutures in closing the anterior sheath and skin.

Very few nerves and blood vessels are cut. We have never found atrophy of the rectus medial to the incision in later reopening this incision. The incidence of pneumonia is so rare that I cannot remember one case. The patient is more comfortable by the mere fact that he has less pain. He breathes much more deeply with a resulting decrease in postoperative respiratory complications.

A not inconsiderable advantage of this incision is that there are no sutures required to hold the enormous intra-abdominal pressure. We never use any form of "through-and-through" suture. Healing is complete and there is no possibility of eviscerating. We have had patients get out of bed during delirium with no ill effects. Comparative proof of all these statements is readily available if upper abdominal surgery is done each way and comparison noted in the way entrance and closure are made. In the unphysiologic incision the aponeurosis fibers snap back like a taut rubber band when severed in distended cases. A great deal of strength is needed to bring them together and it is a question as to whether the sutures will hold. Even when they apparently do hold the resulting scar

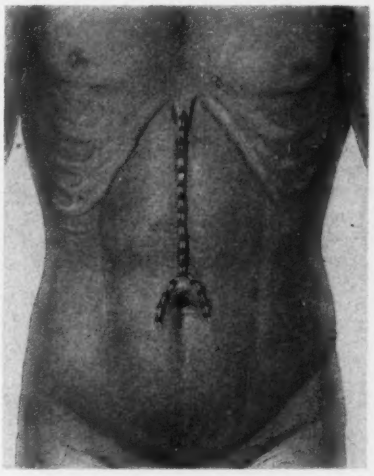

Fig. 18. The skin and fat flaps fall together with surprising readiness. In fact, skin clips are all that are required to hold the flaps of skin and fat together, and the scar is a fine line much superior to that of the usual incisions.

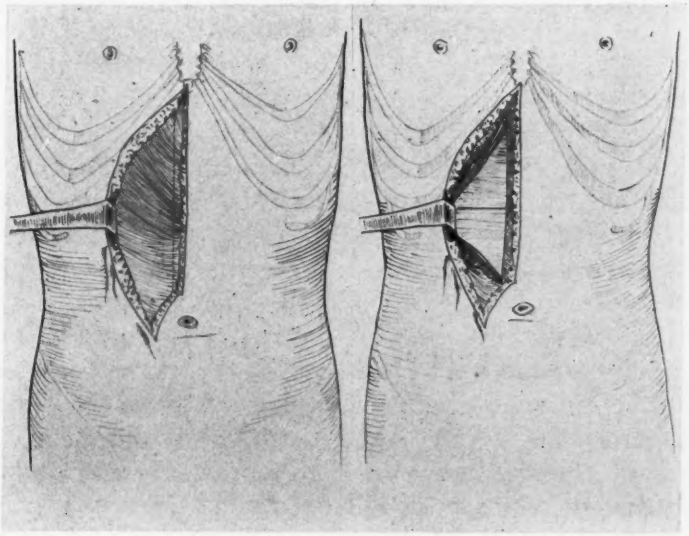

Fig. 19. Keeping in mind the full incision, it is easy to see that in a majority of cases the incision need only be made on one side. Even this unilateral incision has a large advantage over the Winkleman for it may be retracted to reach the appendix and affords a larger and more accessible field of operation. We seldom need to use both sides but often extend the right side incision across the linea alba to the edge of the left rectus muscle.

shows the result of stretching. Nearly always there are adhesions under it and the question is always present as to whether there is a partial hernia and whether the incision will not entirely reopen. In the Sloan incision there is no cutting of musculature under tension, and in closing, the muscles and flaps practically fall together. The skin incision is closed with clips and the resulting scar is a thin line.

Postoperative care is much easier than with the usual incisions. There is no need of silkworm retaining sutures which we use with any other upper abdominal incision. No other upper abdominal incision approaches the perfect physiologic incision so closely and is at the same time so wide in its application.

CONCLUSIONS

Conclusions may be made upon the basis of available material, although it is to be regretted that no figures can be found to bear out the true picture. It is my definite conviction that 15 to 20 per cent is a conservative estimate of incisional failures in operations performed through vertical abdominal incisions. That the incidence is high is proved by the fact that no complete figures have been published upon it.

A survey of a reasonable number of patients operated upon through unphysiologic incisions would be invaluable if:

1. Complete information about the length and location of the incision were given. (It is recognized that a small vertical incision is not nearly so precarious as a longer one, the amount of abdominal strain increasing as the *square* of the length.)

2. Complete information were given as to the extent of the hernia, indicating whether evisceration occurred, whether the closure through the musculature failed to hold, or whether the hernia was occasioned by drainage.

3. The series were carried through a minimum of twelve (preferably fifteen) years.

4. The presence of, and the complications from, adhesions were considered.

5. Some way could be devised to test incision hernia for our records even though it is not bad enough to need re-operation.

We do know:

1. That evisceration occurs in approximately ½ to 1 per cent of all unphysiologic abdominal incisions.

2. Figures published upon postoperative hernia admit 2.2 per cent to 8.9 per cent (from all references). These figures are based upon five years or less and can therefore be accepted as minimal. It would be absurd to suppose that only 2.2 per cent of these incisions produce hernia and .5 per cent (one out of every four) eviscerate. These figures are, of course, compiled about those patients who are reoperated or treated by the original surgeon. It is not known how many from these series go to other surgeons in less or more than five years for repair. Neither is it known how many retain unrepaired herniae.

3. That no figures are available regarding the incidence of adhesions. In 367 cases of postoperative hernia, treated by our clinic, all but four being over five years past original operation, only five had no adhesions. It is only reasonable to estimate a greater number of postoperative adhesions than postoperative herniae. If there is hernia there are adhesions (in 98.6 per cent) and there may be adhesions without hernia.

4. That by using physiologic incisions we eliminate those cases whose mortality is highest, the cases of evisceration. (Mortality is variously placed from 35 to 70 per cent.)

5. That by the same means we can practically eliminate all of the incisional herniae except those which have been caused by drains. These herniae are usually easily repaired under local anesthesia.

6. That in accomplishing the enormous reduction in incidence of hernia we reduce the occurrence of adhesions.

7. In doing all of these things we promote a greater number of patients to a better postoperative condition and reduce mortality. In the process the patient recovers more quickly, endures less pain and discomfort, and makes a comparative financial saving.

We also know that we work longer and harder in the performance of our surgery. Our technique is more tedious and the operative field sometimes confined. Often it is necessary to make two good incisions where one poor one would do. We think it is worth doing.

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APPENDICITIS COMPLICATED BY GENERAL PERITONITIS

A METHOD OF TREATMENT THAT LOWERS THE MORTALITY RATE

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A REVIEW of the literature on acute appendicitis forces upon one the fact that the mortality rate is still much too high. Furthermore, we find that the neglected cases furnish most of the high rate—those that have gone on to perforation with general peritonitis. In this group of cases the mortality rate is variously given between 22 and 63.6 per cent. It is with this group alone we wish to deal, with the feeling that this high mortality is unnecessary.

It is our desire to report a series of thirty-two consecutive cases in this category, treated without a death. We do not include local abscesses or any other form of peritonitis where the mortality is naturally lower. Including these, our series of patients treated in the manner we are to describe is much larger (with the same result), but we wish to deal only with the more severe cases. We do not claim originality; as the literature is reviewed one wonders why the methods have not been more widely adopted.

It is generally conceded that in general peritonitis the problems presented are: (1) removing the focus of infection; (2) procuring as rapid an evacuation of the septic material from the abdominal cavity as possible; (3) preventing sepsis in the abdominal wound, which is supposed by some to be the vital factor in many deaths; and (4) preventing postoperative ileus.

As to the first, there seems to be little doubt at the present time that immediate removal of the appendix is desirable, after a reasonably brief period of preoperative preparation.

The second brings up the problem of drainage. The effect of posture on drainage in general peritonitis has occupied the mind of the surgeon since John G. Clark[1] presented his observations in 1897. He demonstrated:

1. That fluids and solids may pass through the lymph spaces of the diaphragm. He found the diaphragmatic portion of the peritoneum capable of absorbing much gross material.

2. That, as found by autopsy and upon the living patient, the drainage tract, no matter what material was used, always contained organisms of some kind.

3. That there was frequently fluid pent up in the drainage cavity which was sometimes forced into the general cavity.

4. That in many cases in which drainage was used, a sinus persisted six months or more.

He condemned external peritoneal drainage in most cases, and advocated postural drainage into the lymphatic system by elevating the foot of the bed 20 degrees, thus throwing the fluid against the diaphragm where it may be absorbed by the large open lymphatics. The disadvantage of this position soon became manifest and it was early abandoned.

Three years later, Fowler of Brooklyn reported results of nine cases of diffuse peritonitis treated in half-sitting posture.

This position, however, has a number of disadvantages. First, it is necessary to raise the patient so that the long axis of the abdominal cavity is at an angle of 60 or 70 degrees to the horizontal, before the spaces in front of the kidneys will drain into the pelvis. Again, this position tends to throw a decided strain upon a patient with an already weakened heart and lowered blood pressure. Furthermore, it favors gastric distention with its associated ill results. In this position the pelvis is lower than the pubic bones and the escape of pus takes place by siphonage.

Yates,[2] in 1905, reported some interesting observations on drainage. He experimented with all forms of drainage placed in different positions in the abdomen and was able to determine definitely; first, that all forms of drains were closed so that absolutely no drainage from the peritoneal cavity would take place after six hours; second, he concluded that drainage produces a flow of serum lasting from a few hours to two days, which is out of all proportion to the fluid in the cavity to be drained, but in exact proportion to the amount of drainage material inserted, showing that the serum was poured out as a result of the irritation of the drains; and third, he found that gauze will not drain pus or blood. Acting on these he condemned drainage of the peritoneum, as a rule, on the grounds, first, that it is impossible; second, it is depleting; and third, that pus and blood are not drained.

Coffey,[3] in 1906, published his "Principles and Mechanism of Abdominal Drainage," in which he stated that two mechanical principles are involved, gravity and capillarity. There are two steps in the process of drainage: first, bringing the fluid in contact with the drain; and second, delivery of the fluid to the surface. Gravity performs the first step in all intraperitoneal drainage, and, when postural methods are applicable, may also perform the second.

He suggested the well known Coffey dam drain, the principle of which is that two or more parallel tubes bound together work better than a single tube, which may become blocked. He showed that gauze will drain blood and pus because the excess liquid Yates mentioned liquefies and washes out the blood and pus; that the outer end of the drain must be as wide as the inner end and must also be lower than the depth of the cavity to be drained or in contact with similar material which is lower in order that capillary attraction will be continued. He also stated that drains must be left undisturbed for five to fourteen days until the area is completely walled off.

Among his deductions are the following: (1) A tubular drain drains perfectly a walled cavity, or will drain the peritoneal cavity under the influence of gravity if it does not become choked, but will not drain uphill, except when the fluid is confined. (2) There are three cavities or basins of the peritoneum to be drained; the right and the left flanks, separated from each other by the spinal column, and the pelvis, separated from the flanks by the psoas muscles. Either flank holds more fluid, and is an inch deeper than the pelvis, and its bottom is more than 4 inches below the top of the divide made by the psoas muscle, on which the appendix rests. The body must be elevated to an angle of 51 degrees to bring the bottom of the flank on a level with the divide and 60 or 70 degrees to drain properly by the Fowler position. The entire abdominal cavity can be drained by a lateral-ventral position. Coffey also showed that, "a line drawn from the center of the surface of the perineum to the tip of the shoulder will pass through the deepest part of the pelvis and flank." He called these lines the "right and left drainage lines." There are no independent cavities or basins between these lines, and the deepest points of the flanks are best reached externally to them.

In his conclusions Coffey stated: (1) Gravity is the most important principle in peritoneal drainage; therefore, drainage must reach the most dependent point of a cavity to be drained. The patient must be placed in the position that would naturally

cause the fluids in the peritoneal cavity to gravitate to the drain, always bearing in mind the anatomy of the three anatomic cavities or basins above described. (2) Gauze or capillary drainage is the most widely applicable and useful of all drains, if used in sufficient quantity to preclude its being choked by débris, and provided the drain is as large in circumference at its exit as it is at any point within the cavity, and provided also that it is in contact with an abundance of dressings on the outside. (3) If a surgeon remembers that his drain ceases to be effective in a few hours, he places it with the idea of removing septic fluid in the shortest time possible, according to the principles of drainage, and usually gets results. (4) If he is deluded by the belief that his drainage will continue to work for days, and that fluid will run uphill to get to the drains, he will usually place his drains accordingly, and consequently will be disappointed in drainage. (5) If a surgeon habitually removes gauze drainage before it is loosened by the natural process, a large percentage of his patients will have secondary sepsis, postoperative obstruction or hernia. (6) Drainage, except for the small precautionary cigarette or tubular drain, can rarely be safely removed until after the fifth or sixth day.

It is interesting to note that in 1905, Harbin[4] reported a patient treated in ventral decubitus as an aid to drainage for diffuse purulent peritonitis. He reported a patient, aged 44, drained with three iodoform gauze drains, who was put in the lateroprone position for thirty minutes, then shifted to his back for a short period, etc. "During the first six hours the drainage was very large in amount, saturating the dressings and sheets. The amount of discharge in this case by far exceeded what I have ever seen from any other abdominal wound and the amount of toxic material in the peritoneal cavity thus eliminated explained the rapid improvement of his symptoms and final recovery."

W. E. Leighton,[5] in 1914, reported a series of nine cases treated by using the prone position or ventral decubitus. Eight recovered, one died.

Roland Hill,[6] in 1916, reported fifty-seven cases of peritonitis or abscess formation treated in lateral or prone position with two deaths; forty-seven in Fowler position with five deaths—again including abscesses. He stated, "It is generally recognized that the posture in which patients are placed after operations for septic abdominal conditions is an important factor in their recovery. Unless sufficient drainage takes place in the first few hours the patient is likely to die from peritonitis or sepsis. Thus it will be seen that in the gravest surgical cases, it is of the utmost importance to secure at once an unobstructed outflow of all toxic fluids from the abdomen."

Glascock and Glascock,[7] in 1936, reported a series of eighty cases treated in ventral position with a mortality of 3.8 per cent.

Thus we see that the ventral position gives us the most rapid elimination of all the septic material from the abdominal cavity and fulfills requirements more nearly perfect than any other position. This rapid elimination of irritating material also tends to prevent postoperative adhesions and related postoperative complications.

As to the third requisite, prevention of sepsis in the abdominal wound, E. H. Poole,[8] in discussing a paper by Shipley and Bailey on the treatment of appendicitis complicated by peritonitis, in May, 1932, said, "In badly infected cases only sufficient sutures are introduced to close the peritoneum besides the drains; the rest of the wound is left open, for if it is closed above and below the drain, in a few days there is the typical colon bacillus infection, sloughing of the aponeurosis, etc. When the wound is left open there is no sloughing or necrosis, the wound rapidly granulates, no time is lost in convalescence and the incidence of incisional hernia is definitely diminished."

Gamble[9] advised the open treatment of peritonitis secondary to appendicitis, say-

ing, "This plan is founded on the assumption primarily that in 98 per cent of the cases of peritonitis, anaerobic organisms are present; that with the removal of the appendix the peritoneum is able to overcome the infection; that the infection of the abdominal wall plays a more important rôle in the causation of fatal sequelae than any other factor; that the closure layer by layer of the abdominal wall provides both the culture media and an excellent incubator for the growth of anaerobic organisms; that air is a specific for this type of infection; and lastly, that it is contrary to all surgical principles to close a fresh wound which has just been freely bathed in pus." He stated that Heyd in 1911 reported finding anaerobic organisms in 100 of 102 cases studied, while Jennings isolated anaerobic bacteria in 98 per cent of cases of acute appendicitis.

Anaerobic bacteria cannot grow in air. If this factor were taken into consideration in the treatment of general peritonitis complicating appendicitis, it is doubtful if there would be need for bacterins, serobacterins, vaccines, etc., against anaerobic bacteria.

Thus we see that the open wound is the answer to our third problem, the prevention of sepsis in abdominal wounds.

Paralytic ileus is treated mainly by prevention. Our ventral position aids considerably. In a series of major operations in the Presbyterian Hospital we have demonstrated the efficacy of prostigmin for this purpose. This drug maintains the muscular tone of the intestines by preventing parasympathetic paralysis. In large doses it is a parasympathetic stimulant. In our peritonitis cases we found no contraindications to its use and in two patients four months pregnant we used full doses with no effect on the gravid uterus. In our series of cases with the use of prostigmin both pre- and postoperatively, the patient on his abdomen, postoperative ileus was never a problem.

In reviewing and reporting these thirty-two cases from the Presbyterian Hospital (Philadelphia) and the Delaware County Hospital (Drexel Hill), we find several points of interest. The youngest patient was 3½ years of age and the oldest 66 years. There were seven cases between 40 and 50 years of age, more than in any other ten year period. Between 10 and 20 years there were six cases; 20 to 30, five cases; 0 to 10, 50 to 60, and 60 to 70, had four each; there were two cases between 30 and 40 years.

There were eighteen males and fourteen females in the group. Thirty-one of the patients were white and one was black. This is in keeping with other reports which show the relative infrequency in the colored race.

The average onset of symptoms was three to four days before admission to the hospital. The lowest leucocyte count was 5,400, the highest 33,200, and the average 16,800. Eighteen patients gave a history of taking one or more laxatives before admission, citrate of magnesia, magnesium sulfate and castor oil were the most popular. On admission five gave a definite history of diabetes with average blood sugars of 230 mg. One patient had a blood sugar of 278. In addition the urinalysis in nine other cases was positive for sugar which later disappeared. All the patients were operated upon immediately, with either the median or lateral right rectus incision. The appendix was removed in every case. All were drained with one to three Penrose rubber-covered cigarette drains which were removed on the second or third day.

The pathologic report showed either acute gangrenous ruptured appendix or acute suppurative perforated appendix. The pus from the abdomen was cultured in twenty-four cases, with thirteen cases positive for B. coli, six positive for nonhemolytic streptococcus, two positive for Staphylococcus albus, and one positive for pneumococcus.

The peritoneum was closed down to the drains, the fascia and skin left open, and the wound packed with gauze saturated with tincture of merthiolate, azochlor-

CHART I

Case and Hospital	Age	Sex	Color	Days in Hospital	Onset before Operation	Laxative	W.B.C.	Urinalysis Sugar	Highest Postoperative temperature	No. Days before Normal Temp.	Pathologic Report	Culture	No. Drains	Condition of Wound at Discharge
S. D.C.	49	F	W	19	3	Mag. sulf.	15,000	Pos.	101	3	Ac. sup. perf.	.....	1	Small area not healed
D. D.C.	60	F	W	23	2	Castor oil	12,200	Pos.	103.2	6	Ac. sup. perf.	Pneumococcus	2	Small area not healed
S. D.C.	49	F	W	35	2	Citrate	12,900	.....	101	2	.....	Nonhem. strep.	2	Small area not healed
Mc. D.C.	28	M	W	20	4	.....	33,200	.....	101	5	.....	H. strep.	2	Small area not healed
Z. D.C.	65	M	W	22	3	Mag. sulf.	5,400	Pos.	102	6	Ac. gang.	.....	2	Small area not healed
S. D.C.	54	F	W	43	3	Mag. sulf.	23,000	Pos.	104	12	Ac. gang.	B. coli	2	Healed
C. D.C.	10	F	W	27	7	Sal. hepat.	16,500	.....	101	6	.....	B. coli	1	Slight drainage
S. D.C.	66	M	W	20	7	Milk mag.	15,100	.....	102	4	Ac. gang. perf.	H. strep.	1	Slight drainage
E. D.C.	14	F	W	12	3	Castor oil	13,600	.....	101.3	5	Ac. gang. perf.	B. coli	1	Slight drainage
S. D.C.	31	M	W	13	3	Citrate	14,300	Pos.	101	4	.....	B. coli	1	Slight drainage
R. D.C.	13	F	W	11	2	Citrate	15,900	.....	102	3	Ac. sup. perf.	B. coli	1	Healed
R. D.C.	22	M	W	11	2	3 lax.	19,400	.....	102.2	3	Ac. gang. perf.	.....	1	Slight drainage
S. P.	24	M	W	39	2	One	19,450	.....	101	5	Ac. gang. perf.	.....	1	Small unhealed area
D. P.	6	F	W	14	3	One	17,750	.....	102	8	Ac. gang. perf.	B. coli	2	Small unhealed area
P. P.	17	M	W	21	3	.....	15,000	.....	102.4	14	Ac. gang. perf.	.....	1	Small unhealed area
C. P.	9	M	W	20	2	.....	23,000	Pos.	101	3	Ac. sup. perf.	B. coli	2	Healed
W. P.	55	M	W	28	5	.....	10,900	.....	102.2	3	Ac. sup. perf.	B. coli	1	Small unhealed area
I. P.	12	M	W	14	2	.....	23,000	.....	102	5	Ac. gang. perf.	B. coli	1	Small unhealed area
K. P.	65	M	W	15	8	3 lax.	17,400	Pos.	103.3	1	Ac. gang. perf.	Nonhem. strep.	2	Healed
M. P.	41	M	W	19	2	.....	14,800	Pos.	101	5	Ac. sup. perf.	Nonhem. strep.	2	
M. P.	62	F	W	14	2	.....	17,900	Pos.	101	4	Ac. gang. perf.	.....	2	Healed
P. P.	20	F	W	18	2	Citrate	16,650	Pos.	101	5	Ac. gang. perf.	.....	2	
Y. P.	58	F	W	32	7	Cascara	19,000	Pos.	100.4	6	Ac. gang. perf.	B. coli	2	Healed
H. P.	46	M	W	12	7	.....	22,700	.....	104	7	Ac. gang. perf.	.....	1	
H. P.	44	M	W	15	2	Castor oil	11,500	Pos.	102.3	4	Ac. gang. perf.	B. coli	2	Healed
V. P.	17	M	W	16	2	.....	19,300	.....	101.2	6	Ac. gang. perf.	B. coli	1	
S. P.	25	F	W	11	2	.....	13,350	.....	101	5	Ac. sup. perf.	Staph. albus	2	
C. P.	18	F	W	33	3	Citrate	8,300	.....	104	6	Ac. sup. perf.	Nonhem. strep.	2	
K. P.	3½	F	W	17	7	.....	20,150	.....	103	4	Ac. gang. perf.	Nonhem. strep.	2	Healed
W. P.	46	M	W	29	2	.....	16,100	Pos.	103.2	10	Ac. gang. perf.	Nonhem. strep.	2	Healed
V. P.	42	M	W	28	2	.....	16,600	Pos.	103.3	5	Ac. gang. perf.	Staph. albus	2	
B. P.	29	M	B	19	3	Mag. sulf.	19,080	.....	102.3	6	Ac. gang. perf.	B. coli	3	

amide, or similar antiseptic. Deep through and through retention sutures were put in but left loose in order gradually to pull the edges of the wound together as the infection disappeared. When the patient was returned from the operating room he was immediately put on his abdomen and the head of the bed elevated 8 to 12 inches. Routine treatment consisted in hypodermoclysis of saline and glucose and saline intravenously. An ampule of prostigmin was given every four hours and morphia was used for pain. Contrary to expectations the patients complained of very little discomfort because of the position.

It was very interesting to observe, as others who have used the ventral position have observed, that in each case the dressings rapidly became saturated with the drainage from the abdomen, necessitating frequent changing during the first twenty-four hours. The amount of discharge by far exceeded the amount in patients in the Fowler or other positions. This, because of rapid elimination of toxic material, undoubtedly accounted for the rapid drop in the temperature and pulse rate.

As soon as they were tolerated, water and then liquids were given by mouth; after thirty-six to forty-eight hours the patient was put on his back.

The highest postoperative temperature was 104.2 and the average time from the day of operation to the day the temperature reached normal was 5.3 days.

All were discharged from the hospital well after an average stay of 20.9 days and the wounds were healed, with the exception of a small area at the site of the drains in a few of the patients. Twenty-one patients have been followed from one month to two years with excellent results. There was no sign of incisional hernia in any case and all the patients stated that they felt fine and had completely recovered from their operation.

CONCLUSIONS

Excellent results have been obtained with a negative mortality rate in general peritonitis complicating appendicitis by;

1. Immediate removal of the appendix, after a reasonably brief period of preoperative preparation.
2. Ventral position for the rapid emptying of septic material from the peritoneal cavity.
3. Open wound to prevent septic abdominal wall.
4. Use of prostigmin to prevent paralytic ileus.

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TREATMENT AND MANAGEMENT OF BURN CASES*

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MUCH has been written during the past fifteen years regarding the treatment of extensive burns, and especially of the use of agents such as tannic acid, gentian violet, acriviolet-brilliant green, silver nitrate, etc., alone or in various combinations. These chemicals, when applied to the burned areas, mix with the exudate to form crusts or leathery protective coverings. Ten to twelve hours, often fifteen to twenty hours, are required to obtain a leathery coating of the desired consistency. This form of treatment has been hailed by most investigators and generally accepted by the medical profession as a life-saving measure and the best treatment thus far advanced.

Advocates of this method claim in the main that it is a big factor in reducing shock, relieving pain, preventing loss of tissue and body fluids, helping to minimize the toxic stage, controlling sepsis, and speeding recovery. Almost without exception, however, the authors emphasize that the patient should be given the anti-shock measures commonly employed; that fluids be given in large quantities parenterally and by mouth (when possible); that narcotics or potent analgesics be administered to control pain; that provisions be made to control secondary pyogenic invaders; and that blood transfusions are very important. It would appear then, that the crust-forming method affords the patient a protective or leathery coat in the burned areas, but that the fluid loss, pain, toxemia and sepsis have to be met with other measures to enhance restitution and recovery.

No discrimination has been made up to this point between burns caused by fire and those caused by scalds. Although I do not consider the crust-forming method as the one of choice in either event, I might accede to its use in scald cases, but not in those caused by fire. It may be stated in general that most burns produced by scalds are not so deep as those caused by fire; also, that the extent and depth of an injury produced by scalds can be determined within a few hours after the insult, whereas several days, sometimes a week or longer is necessary before the same visualization can be accomplished after fire.

The reason for this is quite obvious. Unless the individual is subjected to a medium of constant thermal potency (several minutes or longer), the damage or involvement after scalds will be much more superficial, due to the fleeting or disseminating property of the scalding liquid and its rapid loss of heat. Using the same time element, fire will produce a much more intense and a deeper burn. Also, it may be stated that, as a rule, scalds will manifest more inflammatory and bullous (exudative) reaction than fire burns, the latter cooking the flesh to such a degree that the vast majority of the areas are dry and remain so for several days. The exudative processes are seared off, so that there is very little loss of tissue or body fluids. The seared tissue thus acts in the same manner as a leathery covering, differing, however, in depth and consistency. What is the advantage gained by covering this already dry area with an additional coating?

It must be admitted that depth plays a rôle in the restoration of the tissues; also, that intensely cooked or burned tissue is, in the majority of cases, dead tissue. Dead tissue acts as a foreign body and restoration cannot take place without a separation and sloughing of this dead or gangrenous material. This is part of the body's defense

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mechanism, and the leathery coat or crust does not, and for obvious reasons cannot, prevent this separation or sloughing. On the contrary, in the vast majority of cases, not only does the sloughing take place, but the crust, unless removed, slows the healing process and traps any pyogenic exudate underneath its tough covering.

If we accept the theory, of the origin of the toxic stage wholly or in part as a result of the absorption of split proteins, or if we wish to recognize the theory of the absorption of toxic material from secondary pyogenic invaders, we certainly could not prevent absorption of toxins from the deeply burned areas by manufacturing a crust over the burn. No matter how aseptic the technique in applying the crust, when the trauma of the burn involves tissues deeper than the epidermis, sloughing must ensue for proper healing and before complete restoration, with or without grafts, can take place. This refers, of course, to deep or "third degree" burns. Certainly no one would consider grafting an area which was obviously unclean. By the same token then, why resort to some measure in deeply burned areas which not only does not enhance the healing, but is contrary to all the laws of natural body defense?

It is also illogical to maintain that the leathery coat or crust makes the patient more comfortable and helps to tide over the interval until sloughing takes place. As stated previously, it usually requires several hours for a desirable coagulated area or firm crust to form. If the burn is extensive, with several areas involved, it means constantly changing the position of the patient in order properly to apply the crusting agent—certainly not a comfortable procedure for the patient. Even after the crust is firm and hard, it is much more difficult to change position from time to time for relaxation or further comfort. The castlike coating precludes this where extremities, and especially joint areas, are involved. If the crust has to be arranged in band-like formation, especially on the extremities, it impedes circulation, acting as a tourniquet.

I fully realize that dehydration plays a big rôle through the rapid and enormous loss of blood and body fluids, but even in untreated extensive (area considered) superficial burns with a marked inflammatory and exudative process, the transudate or oozing of fluids into the burned areas will subside within a few hours. In fact, many of the cases are first seen several hours after the trauma is effected, and after most of the fluid loss has taken place. This loss must be met by parenteral administration of fluids. The leathery crust offers no help where the damage has already occurred or where the process of fluid loss has already greatly dissipated itself.

Therefore, the general supportive measures which are necessary in every case, i.e., intravenous solutions, blood transfusions, proper nourishment, etc., are the actual elements which build up the resistance, help the natural defenses and carry the patient through—not the coagulum.

Many of the statements in the foregoing discussion may seem dogmatic, but I have been forced to these conclusions after careful study and evaluation of many methods and after the supervision of over 2,000 burn cases.

My method of choice, in the vast majority of the cases, is the use of a modified, almost forgotten, water-bath or tubbing procedure.

The patient should be hospitalized. Freshly burned areas, that is, those seen within the first few hours, are not disturbed for at least ten to twelve hours. The patient is merely wrapped in a sterile sheet. This permits a more complete manifestation of the intensity of the burn, and the nature and extent of the injury are better visualized. In the interim, anti-shock measures are enforced. This includes the usual procedures of elevating the foot of the bed, warm covers and heat applications, warm intravenous solutions (the first usually containing 5 to 10 per cent glucose), stimulating drugs, absolute quiet, etc. The

patient is typed and matched as soon as possible and a blood transfusion given during the first twenty-four hours. Thereafter, blood is given often, and the pushing of fluids continued, depending upon the general condition. Suprarenal cortex extract has proven to be efficacious as a prolonged stimulant, and in many cases it was felt that it acted as a life-saving measure during both the shock and toxic stages.

No morphine or allied preparations are used before the patient voids. To begin with the shock produces an oliguria or even an anuria, and to tie up the excretions or prolong the anuria is unwise. If the patient is in a stage of excitement when first seen, or is quite restless or hysterical, one of the barbiturates will usually have the desired effect. Morphine is not necessary in early cases for the control of pain, since little or no pain is experienced after the first several minutes of the injury. The shock stage precludes this, and the deeper the shock the less pain, discomfort or restlessness. Only after the initial rest period and when the patient is completely out of shock, are the burned areas attended to.

After the administration of a mild narcotic, the patient is lifted into a large bathtub filled with hot water (100°F.), to which has been added about one pint of aqueous green-soap solution.* This is a much better preparation than the tinctured solution, in that it is non-irritating and, in fact, very soothing. There is only a minimal amount of discomfort, lasting just a minute or two when the patient is first tubbed. All the torso and extremities are completely submerged; a head rest with an inflated rubber ring will keep the head free. Canvas hammocks fastened with hook arrangements to the sides of the tub and adjusted with ease, may be used; they cause little or no discomfort due to the buoyancy of the body in the full tub.

* The soap solution is prepared in the same manner as the ordinary tincture of green-soap (U.S.P.) except that distilled water replaces the alcohol and the oil of lavender is eliminated. The preparation is, of course, filtered.

The individual is observed very closely and is permitted to remain in the soap solution for five to ten minutes only, depending upon the general condition and tolerance. He is then lifted to a sterile sheet, and a mechanical debridement of all blisters and loose tissue is done as aseptically as possible, using small pieces of sterile gauze. Care must be exercised to get the areas as clean as possible, especially the edges of the wounds. The whole cleaning up procedure should not consume over four or five minutes, even in an extensively burned patient. Dressings of warm dilute Burow's solution (2 ounces to the quart of water) are then applied to all areas involved. For this purpose sterile strips of old linen or cotton material should be used, and several layers applied. Gauze dressings are avoided to prevent firmer adherence or sticking to the wounds.

The dressings are kept wet continuously with the warm solution, but are not changed or removed until the next tubbing period, the following morning, at which time the patient is placed, dressings and all, in the bath containing the soap solution. After several minutes of soaking, the dressings gradually float away from the wounds without any lifting or pulling, and with no discomfort to the patient. The length of stay in the tub is now increased to twenty or thirty minutes, again depending on the tolerance, after which fresh dressings of dilute Burow's solution are applied in the same fashion as previously described without cleaning off the soap solution. The normal skin areas are hurriedly dried, either with a soft towel or a warm-air electric blower. This is a daily procedure.

Upon being returned to bed, the patient is observed for secondary shock, which, if it does occur, is usually very mild. After this the head and chest of the patient should be elevated to prevent hypostatic involvement, his position being changed every few hours for a similar reason. It is not unusual for the patient to fall asleep after the bath, the tubbing procedure act-

ing as a soporific; it is not uncommon for dozing to occur in the tub.

On the third or fourth day the patient will usually tolerate a full hour of tubbing and this may be increased gradually to several hours per session. The patient is then tubbed twice daily, in the morning and again in the late afternoon or evening. All but the head is completely submerged in order to prevent chilling, and the water should be kept at a relatively constant temperature. While he is in the bath, tap water may and should be given freely, and fruit juices may be added.

It is interesting to note with what pleasure patients anticipate the bath procedure; they are, quite often, reluctant to be removed from the tub. The water affords complete relaxation, relieving muscle spasm, pain or discomfort. Movements of the extremities can be accomplished with very little effort. Many patients prefer motion in order to release or remove the dressings themselves, and they become interested in this procedure.

With these daily mild exercises, contractures are, for the most part, either prevented or reduced to a minimum. It is rarely necessary to resort to some orthopedic appliance, but when necessary, this can be applied much earlier by the tub method because the nature and extent of the impending contracture or deformity can be anticipated sooner. Due to the fact that the dressings are not molested, and that they release themselves in the bath, the new granulation tissue is not disturbed: this is an important factor.

Another factor of even greater importance, is that the wounds are cleansed by the weak soap solution, which reduces secondary infection to a minimum. Occasionally a pyocyaneus infection is encountered and is treated with a 1 per cent solution of acetic acid. The odor of pyogenic involvement, so characteristic of burned areas, is absent. With cleaner areas, granulations form much faster, and the manifestation of epithelial islands may be watched from day to day.

In third degree burns, the gangrenous tissue separates and sloughs much more rapidly, and as this process takes place the base of the sloughing area remains clean. This makes for a much faster restoration and proliferation of epithelial tissue. Even after the sloughing is completed, the raw surface will in many instances develop small indented areas here and there, which turn out to be new islands of epithelium. As long as this process continues the tubbing is kept up until the areas are completely healed. If the healing process appears to be at a standstill, the patient is prepared for skin-grafting.

If grafting is necessary, the areas are almost ready for it without further preparation. Many of these cases have undergone grafting without dakinization, and with good results. If dakinization is necessary, it is only for one or two days, using weak solutions. If the area to be grafted manifests exuberant or hypertrophic tissue, the Dakin's solution will reduce them to skin level in most instances, providing that it is applied early and before hardening or complete organization of the scar tissue takes place.

If one area heals in advance of another, the wet dressings are replaced by 5 per cent boric unguent in the healed areas. Vaseline-gauze may also be used. Most investigators will agree that in facial burns, even intensive ones, restoration and healing will take place much more rapidly and with less scarring than in other areas. The wet dressings with Burow's solution will suffice to bring about a proper response in most cases. Occasionally a 2 or 3 per cent ammoniated mercury ointment may be used to prevent or restrain secondary pyogenic infection.

Infants and children respond unusually well to the bath method of treatment. Their handling is, of course, relatively simple in comparison with adults, as they may be lifted in and out of the tubs with ease. Adults, however, very soon become adapted to the manipulation, and their anticipation of the soothing and relaxing

effects of the bath more than compensates for the effort involved in getting them there. Water toys help greatly, in amusing children and in getting them to move various members of the body as they play.

CONCLUSIONS

Accurate comparative statistics for different methods of treatment are not available; comparisons may be made only when like conditions arise. The location, the extent of cutaneous involvement, and the depth of the burn, the age of the patient and the burn itself, together with the general management and treatment, must be considered, as all play an important rôle. One patient with a relatively superficial and limited involvement, may die of a complication such as pneumonia, erysipelas, or post-surgical scarlet. Another, extensively and intensively involved and with a poor prognosis, may sail on to a relatively uneventful recovery. Therefore, deductions as to efficacy of therapy can be made only on a general basis, after thorough practical application and experience.

I feel that the bath or tubbing procedure, as outlined, far surpasses any other form of therapy advocated. Its advantages over the protective-crust or coagulum method are manifold, and may be summarized as follows:

1. Epithelial proliferation and new granulations not disturbed, thereby enhancing recovery.
2. Burned areas are kept much cleaner.
3. No coagulum to trap pyogenic infection.
4. Separation and sloughing of dead tissue occurs more rapidly, leaving cleaner base.
5. Contractures and adhesions are prevented by movement of involved parts; orthopedic intervention may be started earlier.
6. Areas are ready for grafting earlier.
7. The procedure is soothing, comfortable, and practical.
8. No irritation or deleterious effects, attributable to the soap solution, have been observed in any case.

THE TREATMENT OF BURNS*

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EXTENSIVE burns constitute one of the most serious and complicated conditions to be cared for in the realm of traumatic surgery. The course of a burn can be prolonged and disheartening to both the patient and the physician. Burn contractures, especially those involving the head, face, or neck, may result in deformities so severe as to cause an unfortunate victim to lose all semblance of a human being. With these cases there is not only physical damage but enough mental anguish so that an entire personality may be changed. People who have become hideously scarred from burns become self-conscious, invertive, and often develop a definite psychoneurosis. The treatment, therefore, should be thorough in order to prevent deformities and to repair, by plastic surgery, those deformities which do occur.

The largest amount of constructive research and treatment in this field has been accomplished in the past few decades. Before this the treatment of burns was largely empirical.

Children are more frequently burned than adults. Of the fatal burns occurring annually in the United States, 45 per cent are in children under 6 years old.[1] At the Children's Hospital in Detroit the greatest number fell in the age group of 1 to 3 years.[2] Children and the aged tolerate extensive burns poorly. Low[3] reported that scalds caused 57 per cent and matches or fire 20 per cent of the burns of the children admitted into the Children's Hospital at Boston. The prevention of burns should be stressed, particularly in localities where open heating systems (gas and gasoline heaters) are commonly used. A publicity campaign stressing the danger of burns and means of avoiding them would be a valuable form of prophylactic treatment.

Methods of treatment of burns are legion, and it is most probable that they began with the discovery of fire by man. Burns must have been one of the first conditions ever to receive treatment. Until 1925 when Davidson[4] advanced his theory of toxemia and advocated tannic acid treatment there had been little reduction in the high mortality rate of burned individuals. Tannic acid was not new, however, as the Chinese were using infusions of tea leaves for burns as early as the sixth century B. C., tannic acid from the leaves accounting for the efficacy of this treatment. In 1890, an anonymous author published a paper in the Pittsburgh Medical Review recommending the use of 5 per cent tannic acid on burns.[2] Unfortunately, this plan of therapy was not adopted, and until 1925, pastes, oils, ointments, paraffin, etc., constituted the accepted treatment. Willems and Kuhn,[6] reported that 1,206 burned individuals had been treated by 386 physicians and given forty-seven different types of treatment. The majority of methods used in treating burns have been aimed at allaying pain and to a large extent this still holds true.

Burns have been variously classified, Dupuytren naming as many as eight degrees. A simplified classification, now commonly used, groups major and minor burns. A minor burn is one involving not over 15 per cent of the body surface and so situated that the patient may remain ambulatory. A burn of the face involving so large an area should be classified as a major burn due to its location and the constant care necessary. Major burns are those involving over 15 per cent of the

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body surface. Both of these groups are divided into three degrees. The first degree burn shows simple erythema of the burned surface but no vesication or necrosis. A second degree burn produces destruction of the epidermis with erythema, vesicle, and bulla formation. A third degree burn varies from complete destruction of the skin to involvement of the deeper structures.

Another type of burn which should receive consideration may, for simplicity's sake, be termed the "inhalation burn." This is caused by inhaling hot fumes or caustic chemicals, and is an insidious and dangerous form of injury, often fatal, whose seriousness is frequently not recognized until late. The scope of this paper does not include a discussion of this latter type of burn but confines itself to the treatment of burns of the body surface.

Davidson's tannic acid treatment was based on the theory that there was absorption of a proteid substance from the burned area, causing a toxemia. This view was supported by the experimental work of Robertson and Boyd,[7] but Underhill and his co-workers[8,9] found that there was a greatly diminished rate of absorption from the burned area. It was also found that there was an increase in capillary permeability, causing a shift of the water balance and resulting in anhydremia due to loss of fluid from the blood to the injured area. In experimental animals a third degree burn of one sixth of the body surface caused a fluid loss of 70 per cent of the total blood volume in twenty-four hours. During this period there was a decrease in the blood cholorides, a depletion of adrenalin in the blood, and a distinct increase in hemoglobin. Blood urea and non-protein nitrogen remained normal and there was no acidosis.

The cause of shock and the associated symptoms during the first forty-eight hours following a burn can be explained by the anhydremia which produces an increase in blood viscosity. The result is a diminished heart output, a slowing of the circulation and anoxemia, with incomplete excretion of the toxic waste products of metabolism. The want of oxygen may be partially responsible for the degenerative changes of the liver, adrenals, spleen, and kidneys observed after fatal burns.

About the second or third day following a burn, symptoms develop which cannot be ascribed to the loss of body fluids. At this stage definite signs of toxemia appear, namely, malaise, chills, fever which may range as high as 105 to 106 degrees (of the "picket-fence" type), drowsiness, restlessness, muscle twitching, and periods of irrationality. Adequate fluids, although essential in this period, do not relieve these symptoms and findings. It was reasoned by Firor and Aldrich[5] that an extensive infection of the burned surfaces could be responsible for the toxemia. By culturing the burned areas they found that there was very little bacterial growth in the first twelve hours. Following this relatively sterile period, staphylococcus, B. coli, and streptococcus were found in 100 per cent of the burned cases, with the last named predominating. As the signs of toxemia increased a greater concentration of streptococci was found.

An understanding of the physiology of burns clarifies the treatment necessary. The treatment of minor burns should consist of: (1) alleviation of pain; (2) prevention and treatment of infection; (3) orthopedic care (as in burns of the hands, antecubital or axillary areas) to prevent contraction deformities; (4) reconstructive surgery when indicated. In major burns the treatment is roughly divided into the following stages: (1) treatment of shock, pain, and anhydremia; (2) prevention and treatment of infection; (3) prevention of exhaustion; (4) orthopedic care to prevent flexion deformities; (5) reconstructive surgery.

MINOR BURNS

The most important phases in the treatment of minor burns are the prevention of infection and the relief of pain. Early it is often difficult to determine the depth of the

burn, as erythema and pain may be the only evidence of thermal injury. Later, vesicles may appear or the epidermis may slough, showing the presence of a third degree burn. Due to the fact that the diagnosis of a second or third degree burn is obscure when a burn is first seen, oils, greases, and ointments should not be applied as a remedy. These greasy agents, aside from their analgesic effect, have no proved therapeutic value. Grave reactions have occurred following the use of some of these due to the patient's sensitivity to the drug.[10]

If it can be definitely ascertained that the burn is of first degree, a sterile vaseline gauze dressing may be sufficient. Mercurochrome 5 per cent,[11] gentian violet or ferric chloride 5 per cent[12] covering the erythematous area are in the line of good treatment. Later if blebs appear the field has been kept sterile and no greasy substances are present to invite infection. The blebs should be aspirated by a sterile needle introduced into their base. A compression bandage is then applied to prevent the protective epithelium from being loosened. Often the epidermis of the blister will become revascularized with a complete and rapid cure.[13] A second or third degree burn of a part such as the hand or foot should be treated with tannic acid and silver nitrate (described below). This simplifies dressings, is a worthy analgesic, and prevents infection. If pain is severe a suitable dose of morphine or codeine should be given immediately. A burn situated over a joint may be painful due to motion, and immobilization of the joint is indicated in these cases. The treatment of infection, prevention of contractures, and application of reconstructive surgery is similar to that described under major burns.

MAJOR BURNS

Most major burns occur among the indigent. This is due in large part to housing conditions, heating units, and the fact that these families tend to have more children. These individuals can least afford hospitalization and nursing care, yet they need careful treatment and laboratory facilities which can be obtained only in a hospital. Often by the time these patients arrive in a hospital they are thoroughly chilled from transportation in wet clothing, or they are covered with a greasy substance that insures infection.

Soon following a major burn the patient usually presents a definite clinical picture characterized by intense pain, lowering of the blood pressure, a fast pulse of poor volume, rapid shallow respirations, anxious face and restlessness. These signs are due to primary shock and probably to vasodilatation of the splanchnic area.

There are some patients with severe major burns who do not show primary shock, are fairly comfortable and appear to be in good condition when first observed. After an interval of approximately six to ten hours the symptoms described above appear. This condition is known as secondary shock and is due to depletion of the blood fluids. This form of shock frequently appears in patients who have rallied from primary shock and were seemingly improved.

Statistics show that 60 per cent of deaths from burns occur in the first twenty-four hours.[14] Treatment therefore should be instituted early. As soon as a patient with a major burn is seen, all wet clothing should be cut and removed. If an attempt is made to save clothing by pulling arms out of sleeves, pulling clothes over the head, etc., a portion of the epithelium may be torn away and a raw area liable to infection created. Morphine should be given, since pain, as well as fluid loss, is a prime factor in shock. The patient is placed in warm blankets to exclude the air. If a patient feels chilled or shows a subnormal temperature, external heat should be applied and the victim hurried to the nearest hospital. It is dangerous to treat the burn itself in any manner until the period of shock is well under control. Patients with major burns who do not appear to be in shock should be treated as if shock were present—it invari-

ably will occur sooner or later. Delayed shock is often more severe than initial shock and is more difficult to treat; consequently it should be averted. The shock accompanying burns is treated in the same manner as "surgical shock" by giving fluids, stimulants, morphine, external heat, and elevating the lower portion of the body.

As soon as the patient is safely out of shock the burned area should be treated. If there has been an application of grease this must be removed by placing the patient in a tub of warm water in a *warm* room and gently cleansing the area with green soap and water. Following this the patient is moved to sterile sheets and a light anesthetic is administered. Pentothal sodium has been used intravenously in a few cases when smaller areas have been involved, but a gas or gas-ether anesthetic is generally more satisfactory. When there is an associated "inhalation burn" inhalation anesthetics are contraindicated due to the edema of the lungs, and a rectal anesthetic such as avertin should be used. A complete debridement of the burned surface can be accomplished by using a soft scrub brush and scrubbing all burned areas with green soap and water. It will be found that the burned epithelium can be rapidly removed by this method. The entire injured surface is then copiously irrigated with sterile saline or water. Any remaining grease can be removed with ether.

Some writers have advocated irrigating the injured areas with mild antiseptics such as hexyresorcinal, merthiolate solution, etc. We have used these preparations, but it is an expensive procedure, and although no harm is done by their application it seems wise to await more confirmation of their value before advocating their employment.

Following the irrigation the patient is dried with sterile towels, and 5 per cent tannic acid is sprayed over the burned areas with an atomizer. A solution of 10 per cent silver nitrate is applied over this. A fresh cotton swab should be used for each application to prevent tannic acid being carried into the silver nitrate container. The rapidity of the formation of a coagulum is surprising. Bettman's[14] tannic acid-silver nitrate treatment is vastly superior to the use of tannic acid alone. When tannic acid is used alone, it must be sprayed on every fifteen minutes for a period of twelve to twenty-four hours before a proper eschar is formed. By using tannic acid and silver nitrate in combination, this can be accomplished in fifteen minutes. The almost instantaneous sealing of the burned areas inhibits pain, stops the fluid loss, protects the raw area from infection, diminishes the incidence of delayed shock, simplifies the nursing problems, and leaves a pliable coat over the joints. Tannic acid alone has other disadvantages; when infection sets in under the thick eschar there is no local evidence of what is going on. It is also painful, often cracking, when applied over a joint. It has been shown that epithelium can be destroyed by tannic acid,[16] and a red inflammatory area exists in the surrounding zone of a burn following its use. When the tannic acid-silver nitrate solution is used this is not found, nor is the albuminuria present that is commonly associated with burns. There is apparently no danger from argyria as no evidence of silver absorption has been noted.[15]

After completion of the tan the patient is placed in a "heat cradle," consisting of an electric lighted tent which holds the sheets from the patient, assures the patient ample freedom, and keeps the bed comfortable and warm. A thermometer is suspended from the top of the tent in order that the temperature may be controlled. At from 85 to 88°F.

It is most important that the patient receive adequate fluids and chlorides. One liter of fluid should be given for every 25 pounds of body weight every twenty-four hours. Hemoglobin determinations are an invaluable aid in determining the amount of anhydremia present and how successfully it is being combatted by fluid administration. To maintain the water balance in children the continuous intravenous drip is

very practical. Anchoring a number 4 ureteral catheter in one of the ankle veins permits limited motion of the leg. Adults are given normal saline with 5 to 10 per cent glucose intravenously at intervals until the necessary amount can be taken orally. Nausea and vomiting occasionally occur during the first forty-eight hours, the latter sometimes being obstinate. If 500 c.c. of a 3 per cent saline solution is given, very slowly, intranveously, and these symptoms are completely abated. When the hemoglobin reading is nearing normal, care should be taken to prevent too large an amount of fluids being given. Children should be especially watched for edema. Edema may not only be due to an excessive amount of fluids but may be the result of a salt block due to retention of chlorides. If a salt block exists 1,000 c.c. of distilled water with 10 per cent glucose given intravenously will immediately relieve the edema and associated symptoms.

After several days the patient's temperature should recede and approximate normal. If this has not occurred and signs of toxemia are present, a search should be made for an infection. Burns which have had grease applied, burns around the perineum, burns involving both sides of the body so that the patient is forced to lie on a burned area, or burns whose crust has been loosened, are prone to infection. Fluctuation of the eschar, tenderness, and localized elevation of the tan usually reveal the location of purulent material. The tan should be removed in this region, and the septic area allowed to drain. Wet packs of ¼ per cent chlorazene solution are used to clean the wound of gross infection.

Until the burned areas are entirely healed supportive treatment is essential. Patients with extensive infected burns will eventually succumb unless given every aid in the surgeon's armamentarium. These patients show progressive anemia, anorexia, weakness, and gastrointestinal symptoms; unless they are carefully treated, they waste away and die from exhaustion or from some concurrent disease. The most valuable medicines that we have to combat this decline are blood transfusions and an adequate diet. Frequent small blood transfusions are an excellent tonic, much more beneficial than the large transfusions given as a last resort. "Last resort" transfusions in burns are seldom life saving. We favor the use of citrate blood transfusions as the patient's veins are saved. In addition, it is more convenient, avoids the necessity of moving the patient, can be better controlled, and has all the advantages of whole blood in these cases. Transfusions are indicated when there is a fall of hemoglobin or other evidence of anemia, when the food intake has been limited, when the healing process is slow or at a standstill, or when the plasma protein is near 5.0 Gm. per cent.

The diet should be high in calories, easily assimilated, and of a high vitamin and mineral content. During the healing period the caloric intake of adults should exceed 2,500 calories daily. A sick individual cannot be forced to eat a routine diet and should be allowed to choose his menu as long as it contains the necessary elements. Sixty per cent of the body sulfur is contained in the skin and the sulfur derived from a diet containing eggs definitely promotes epithelization.

It is feasible to remove the coagulum as soon as the epithelium has regenerated. This usually begins taking place at the end of seven to ten days, at which time the tannic acid-silver nitrate coat will be seen to curl at the edges. No definite time can be set for removing the eschar as this factor depends on the individual healing factor and the depth of the burn. Bits can be removed from time to time, but unless there is an infection present or the eschar is loosened by underlying moisture the crust should remain at least three weeks if healing has not taken place.

When any unhealed or infected areas remain, the area should be skin grafted as soon as possible. The ideal site for a skin graft is a bed of vascular granulation tissue free from gross infection. In most instances the constant use of ¼ per cent chlorazene

packs will promote healthy granulations. In certain individuals a purulent fibrous exudate appears over the burned surface. In these cases hot water soaks and manual removal of the exudate improve the granulations. Even though handled properly, some burns reach an indolent stage when there is little or no proliferation of epithelium or granulation tissue. Ultra-violet therapy is a benefit in these cases.[17] If this is not available the heat of an ordinary light bulb will increase circulation. Transfusions are an adjunct in stimulating tissue growth, diminishing infection, and should always be given when the healing process is slowed. Scarlet red ointment, cod liver oil ointments, or applications of oxyquinoline sulfate scarlet R gauze[14] promote epithelization and may be used in this indolent stage. They should not, however, be applied over infected granulation tissue.

Some burns are not seen by a surgeon until long after it has been treated by home remedies, ranging from soot to advertised salves and greases. By this time the patient is debilitated and the burn infected, covered with a purulent crust, and looking like an old ulcer surrounded by an area of cellulitis. Blood transfusions, proper diet, removal of the crusts by warm water soaks and the use of chlorazene packs aid the patient's condition and render the injured region amenable to skin grafting.

Areas of exuberant granulation tissue may form and prevent the ingrowth of epithelium. If such a condition exists the granulations can be controlled by cauterizing them with lunar caustic and applying pressure dressings of mesh gauze held in place by an ace bandage.

Second or third degree burns over joints invariably cause scar contractures or flexion deformities if not properly treated. Their prevention is less difficult than their cure and, for this reason, any joint in the region of the burn should be placed in extension and splinted.

The optimum time to begin reparative work is before scar tissue forms contractures. When the granulation tissue has a beefy red, clean appearance with a thin blue line of epithelium growing at the edges of the raw area, conditions are right for skin grafting. Since whole thickness grafts are disfiguring to the donor site and prone to fail because of poor viability, Ollier-Thiersch grafts which bisect the papillary layer of the skin seem most satisfactory. Pinch grafts have their value in burns with infected granulation tissue where only small clean areas are present to receive a graft, or where burns are so extensive that the donor sites are too small or poorly located for Thiersch grafts to be obtained. Although it has been shown that homoplastic grafts do not remain permanently,[18] homografts are at times indicated. In massive burns, when the patient's condition continues to decline, it is dangerous to increase the amount of raw body surface by removing skin for autografts. By covering the granulating surface with grafts from another individual of the same blood group the raw areas are temporarily healed. During this period the patient is saved the disastrous effects of septic absorption. Autoplastic grafts can be applied in two to five weeks when the homoplastic grafts disappear.[19] The technique of skin grafting and reconstructive surgery is not discussed in this paper as this is an entire subject in itself.

SUMMARY

1. The use of greases, ointments, or salves is contraindicated in the treatment of burns.

2. Due to the shift of the water balance in burned patients, large amounts of fluids are indicated to prevent delayed shock and symptoms of anhydremia.

3. The burned areas are not to be treated in any manner until the patient is well out of shock. Then they are treated like surgical wounds, by debridement, tannic acid 5 per cent, and silver nitrate 10 per cent applied to the injured surfaces with aseptic technique.

4. Exhaustion and debilitation must be avoided by frequent blood transfusions, proper diet, and care of the infected area.

5. Skin grafting should be done as soon as the granulations permit and flexion deformities prevented by extension splints over joints.

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TRAUMATIC TORSION OF THE OVARIAN PEDICLE*

A MEDICOLEGAL STUDY WITH PRESENTATION OF CASES AND REVIEW OF THE LITERATURE

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"TRAUMA, industrial and non-industrial is increasing so rapidly that it now occupies almost a dominant position in the practice of surgery," (Lazenby[96]).

With the ever widening scope of compensation insurance as well as the tendency of attributing nearly every disease to accidental injury, traumatic medicine and surgery has increasing importance to every member of the profession. Many conditions have only recently been accepted as being sometimes caused by injuries. Among these are ulcers of the stomach,[70–78] appendicitis,[1–19] certain heart conditions,[69] and even cancer, although this is still being contested. It has become the tendency of patients, often inspired by a desire for financial reward, to claim that illness resulting almost any time after the injury was initiated at that time. The final decision is often made by a jury of laymen and precedent established without scientific basis. It is consequently apparent that there is need for further study and reporting of every case which is caused or claimed to be caused by injury.

Personal experience in two cases of torsion of the ovary in which trauma was accepted by insurance carriers as the initiating factor has stimulated the following paper.

All case reports of tumors of the ovary, including those of torsion from 1925 to 1936 at the Binghamton City Hospital, were examined. The literature of twists of the ovary was also carefully studied. In view of the fact that our interest lay almost entirely in the traumatic angle, a review of the literature aside from that relevant to the subject has been omitted. The reader is referred for more complete data to the excellent articles by Wong[67] and Haines and Edgerly.[37]

It also seemed to the writers that the rôle of trauma as an etiologic factor from the legal point of view would contribute to the value of this study. We have, therefore, incorporated a brief but fairly complete statement as to what in general constitutes legal liability in any pathology following an alleged trauma and also a discussion of our cases from the legal viewpoint.

Torsion of the ovary has been reported since 1842[37] and is a fairly common occurrence in surgical practice. The etiology, however, has never been scientifically investigated. This is probably due to the fact that the posture which is present in man and which apparently plays such a part in producing the condition is not present in the animals available for experimentation. Study in the main has been along clinical lines with rationalization following the finding of the torsion.

Haines and Edgerly[37] mention as etiologic factors sudden movements such as falling or slipping, exertion such as cough-

* From the Surgical Service of the Binghamton City Hospital.

ing and sneezing, alternate distention and evacuation of the bladder and even the passage of feces through the rectum. Pressure of a pregnant uterus or emptying of the uterus may also be exciting causes. Unequal growth in a tumor[23] is mentioned in slow torsion.

In the early editions of Graves' "Textbook of Gynecology," trauma was one of the causes mentioned. The latest edition, however, has omitted this. Trauma is also mentioned in many other articles examined by the writers. Wong[67] lists trauma as a cause, but classifies under this heading such things as jolts, falls, sudden changes of posture, and so forth, which are not so classified by other writers. Only four cases in the literature available to the writers were found in which a single direct and definite trauma was the precipitating factor in the ordinary sense of the word. Darner[32] cites the case of a child who was kicked in the abdomen. This was followed by pain and a progressive condition found at operation to be due to torsion of an ovary. Wong cites one case in which the condition followed a fall. He also cites a case under the heading of trauma which followed the lifting of heavy luggage. Cohen[27] reports a case in which sharp pain followed the lifting of a mattress. At operation torsion of a fimbrial cyst was found.

Two factors must be present in every case of torsion of the ovary; first, a free tumor and second, an elongated pedicle.[23,37] Even then torsion occurs in only a few cases. Graves[36] states that twisting occurs in 10 to 20 per cent of ovarian tumors. Payr (quoted by Haines and Edgerly[37]) showed by a model that increase in the venous pressure of the pedicle without increase in the arterial pressure tends to produce torsion without other contributing factors. Anything, therefore, which causes a slowing up or blocking of the venous return may cause torsion. "Torsion of the pedicle of an ovarian cyst may begin suddenly and in the space of a few hours cause acute symptoms. It is probable, however, that in the majority of the cases the torsion tends to occur slowly, little by little, extending over a period of weeks or months or years; then even a very slight increase in this slow torsion may suddenly bring on acute symptoms."[37]

The rapidity with which symptoms occur following the torsion is of paramount importance in determining the etiology. The first sign which calls the attention of the patient to trouble in the acute cases is pain. We have carefully tried to ascertain from previous reports and books on pathology just when this first occurs. Due to complete absence of experimental evidence the subject is a matter of conjecture. The only conclusion possible is that interference with circulation if severe enough and of sufficient rapidity will cause pain. That the onset of pain does not necessarily mark the initiation of vascular pathology was brought out in the analagous condition of mesenteric thrombosis by Warren and Eberhard. The pain is caused only by circulatory interference and this may occur anytime during the process. This fact is important in any determination as to etiology. In examining case reports cited there is usually a history of repeated attacks of pain occurring over a period varying from hours to years. In some cases the beginning of the attack was definite and the condition progressive. In nearly all, however, careful questioning elicited the history of similar but subsiding attacks.

Without repeating the reports in detail the following conclusions may be drawn from the literature on the subject. Pain indicates fairly rapid impairment of circulation. The pain may be transient, the impairment being sufficiently corrected to relieve this symptom, either by untwisting completely, or to some degree. The twisting may persist and be compensated, as indicated by recurring attacks of pain coupled with increasing size of the tumor and abdomen. The number of times that twisting and untwisting may occur and the exact factors which cause them remain conjectural. If the interference with circulation is sufficient the condition is pro-

gressive and irremediable. Surgery is always indicated at this time.

At this point we submit a typical case report by von Graff.[64] This embodies the factors mentioned above and also involves the question of trauma as an etiologic factor. Two days following an auto accident, a patient near term was delivered of a dead child. Soon after delivery she experienced pain in the right lower quadrant. This pain persisted off and on with exacerbations at the menstrual periods and with increasing size of the abdomen. At operation one year later, a large twisted ovarian cyst was found. The cause given by the writer for the torsion was the delivery. No history was given of any injury to her abdomen at the time of the accident and trauma was not considered as a possible cause. If claimed, trauma might reasonably have been accepted as a causative factor.

During the ten year period (1925–1936) 221 cases were operated on. The greater number were simple cysts and the types and percentages generally fell within the ranges reported elsewhere.[23,66] There were two cases of ruptured cysts; two were gangrenous; pregnancy was associated with eight of the simple cysts; seven ovarian cysts were infected; there was one case of pseudomyxoma peritonei.

There were five deaths in this series. These all occurred in complicated cases. One was a case of ruptured ovarian cyst with marked intraperitoneal hemorrhage simulating an ectopic pregnancy. The wound broke open within twenty-four hours and was immediately resutured with a fatal result. Another death occurred in one of the seven cases of infected cysts. The other three were operated for intestinal obstruction. Two of these had had previous operations and the ovarian pathology was found at the laparotomy. The other case was diagnosed as twisted ovarian cyst with intestinal obstruction. At operation, adhesions between the bowel and the ovarian tumor were so dense that resection was necessary. End-to-end anastomosis by means of a Murphy button was done.

TABLE I

OVARIAN TUMORS 1925–1936
Binghamton City Hospital

Type of Ovarian Tumor	Number Unilateral	Number Bilateral	Deaths	Complications
Simple cyst	150	14	4	Torsion in 9 cases.
Pseudomucinous cyst	5	1	0	One case of pseudomyxoma peritonei.
Multilocular cyst	8	0	1	Torsion in 3 cases.
Dermoid cyst	7	2	0	
Cystic carcinoma	6	3	0	
Serous papillaryous cystadenoma	7	3	0	Torsion in 2 cases.
Fibrosis	3	0	0	Torsion in 1 case.
Fibroma	6	0	0	
Chocolate cyst	4	1	0	
Sarcoma	1	0	0	
	197	24	5	

Included in the 221 cases were fifteen cases of twisted ovarian cysts. There was no mortality in this group.

In analyzing the fifteen cases of torsion of ovarian pedicle, no great variation from previously reported series was noted.[23,66] The greater proportion was in married women (nine) and on the right side (twelve). The age range and the pathology followed the literature.

The types of tumors found were at variance with the larger series reported by

TABLE II

TORSION OF OVARIAN CYSTS 1925–1936
Binghamton City Hospital

	Case Number	Married or Single	Age	Presence of Trauma	Onset		Duration	Association with Pregnancy	No. of Prev. Preg.	Presence of Mass	Preoperative Diagnosis	Operative Findings
					Sudden	Gradual						
1.	A5214	M	16	..	x	..	2 wks.	..	..	x	Twisted right cyst.	Torsion of simple right ovarian cyst 1½ times.
2.	95203	M	45	..	..	x	3 yrs.	..	4	x	Twisted right cyst.	Torsion of simple right ovarian cyst with hemorrhage.
3.	89300	S	28	..	..	x	4 mo.	..	..	x	Twisted left cyst.	Torsion of normal left ovarian cyst with hemorrhage.
4.	97192	M	36	..	x	..	6 mo.	..	..	x	Twisted right cyst, intestinal obstruction.	Torsion of simple right ovarian cyst with adherent bowel and intestinal obstruction.
5.	70000	M	23	..	..	x	6 mo.	..	..	x	Strangulated right ovarian cyst.	Torsion of multilocular right ovarian cyst.
6.	61191	M	29	..	..	x	3 yrs.	..	..	..	Undetermined.	Torsion of simple right ovarian cyst with gangrene.
7.	89354	M	42	x	..	x	7 wks.	..	4	x	Twisted right cyst.	Torsion of simple right ovarian cyst with hemorrhage.
8.	A511	S	43	..	..	x	5–6	..	..	x	Twisted right cyst.	Torsion of simple right ovarian cyst with gangrene.
9.	94822	S	31	x	x	..	2 da.	..	..	..	Twisted right cyst.	Torsion of multilocular right ovarian cyst.
10.	36090	S	27	..	x	..	5 da.	..	..	x	Twisted left cyst.	Torsion of simple left ovarian cyst with hemorrhage.
11.	39433	M	37	..	..	..	.....	..	..	..	Twisted right cyst.	Torsion of papillary cystadenoma of right ovary.
12.	47693	S	16	..	x	..	6 da.	..	..	..	Perforated appendix.	Torsion of simple right ovarian cyst with hemorrhage.
13.	54030	M	31	..	..	x	4–6 mo.	x	..	x	Pregnancy and cancer of omentum or pedunculated fibroids.	Torsion of multilocular ovarian cyst.
14.	46219	M	38	..	x	..	.....	x	..	..	Right ectopic.	Torsion of papillary cystadenoma of right ovary.
15.	45842	S	13	..	..	x	.....	..	..	..	Appendicitis.	Torsion of simple right ovarian cyst.

Bernstein,[23] inasmuch as nine were simple cysts, three papillary cystadenomata and only one was a solid tumor. The solid tumor was 12 by 9 by 6 cm. and consisted entirely of a moderately hard encapsulated mass which was hemorrhagic. It had a solid beefy appearance and grossly was infiltrated with blood. Microscopic examination showed a normal ovarian stroma infiltrated with large quantities of blood. Infarction was present in some places. Baron[21] also reports torsion of a normal ovary.

The symptoms varied from two days to three years or more in duration. Where a careful history was elicited this period could be stretched indefinitely. This is of great importance in attempting to state when the trouble started and in formulating an opinion as to the immediate cause. In thirteen cases the onset of symptoms was without apparent immediate cause. Two patients gave a history of pain following trauma. Both of these were accepted legally as such and compensation was awarded.

The first case was in a middle aged obese woman who was riding in the back of an automobile with a dishpan containing produce in her lap. The front wheel of the car was struck by a train, throwing her violently forward and forcing the side of the dishpan into her abdomen. Following this she experienced severe pain in her abdomen with vomiting and was put to bed for four days. She improved for the time being and was able to do her work off and on for seven weeks, with occasional periods of bed rest. During this period she was repeatedly examined by the surgeon for the railroad company who considered the condition due entirely to bruising of the abdominal wall. At times she had intense abdominal pain with vomiting but these were of short duration. At no time did she have any bowel or urinary disturbance. The day before admission the pain became more severe and she vomited constantly. Her bowels moved, however, without difficulty. She became rapidly worse and was therefore hospitalized. On admission examination revealed a large abdominal mass which was diagnosed as a twisted ovarian cyst. At operation, a torsion of an ovarian cyst the size of a large grapefruit was found. The circulation was impaired to such an extent that the mass was almost black. On section, the ovary was found to be filled with dark blood.

In this case, a violent direct external blow was given to the abdomen. This was followed immediately by symptoms suggesting internal injury. These symptoms persisted and finally culminated in an acute abdomen necessitating surgical intervention. The pathology at operation was clearly consistent with the trauma sustained. We feel that the injury first produced either a hemorrhage into the cyst or an edema of the tumor which caused impairment or retardation of the venous return. This venous obstruction caused a gradual progressive further impairment of the circulation with the twisting caused by such pathology, as demonstrated by Payr (quoted by Haines and Edgerly[37]). In our opinion the blow did not cause a twisting of the ovary immediately, such as would occur in striking a ball on a string. The twisting came secondarily. The initial pain was probably due to bruising of the abdominal wall as well as to injury to the ovarian cyst. Later, the pain of torsion was superimposed. We do not feel that the torsion was complete at first. The terminal pathology could not have lasted seven weeks without gangrene and peritonitis. There was, however, sufficient trauma to cause the production of the pathologic condition necessary to initiate this torsion. The history, aside from the trauma, could be reproduced from other cases in our series.

The second patient presented an entirely different picture. An unmarried waitress of 31 years, while lifting a tray, experienced a sudden sharp pain in her right side radiating to the right thigh. The pain was well localized, and persisted off and on for two days. She was in bed during this period. Before admission she developed frequency and tenesmus. Her menstrual history was essentially negative. The bowels moved without difficulty. A diagnosis of acute appendicitis was made and the patient referred to the Binghamton City Hospital. On admission she had a normal leucocyte count and no elevation of temperature. Examination showed muscle spasm in both lower quadrants. Rectally a mass the size of a small orange was noted in the cul-de-sac. A diagnosis of twisted ovarian cyst was made and substantiated at operation. The cyst was

twisted two and one-half times. The tube was also twisted but without interference to its circulation. The color of the ovary was good. Impairment of circulation was apparently restricted to venous compression.

This patient had been a waitress for many years. The lifting of the tray was a frequent daily occurrence with her. There was no unusual circumstance associated with the pain, such as slipping or tipping of the tray, necessitating sudden change in posture.

The pain was, of course, due to impairment of circulation caused by twisting of the pedicle. Just why the pain should have occurred at the time stated is the point in question.

Gardner (in Dean Lewis' "Practice of Surgery" states that torsion *is said to follow some unusual exertion*, such as reaching up high. In this way the recti muscles are put on an unusual stretch, thereby obtaining a new grip on the cyst and rotating it. In our case the cyst was apparently not of sufficient size, to enable this phenomenon to happen. Again referring to the analogy of a ball on a string, it seems impossible that the cyst was twisted two and one-half times by one act.

Two inferences are possible. The first is that the pain was caused by immediate twisting with instant impairment of circulation. We cannot in the absence of experimental evidence disprove this hypothesis. The absence of marked interference of circulation two days later, even with the pedicle twisted two and one-half times, would suggest that the condition had not changed materially since its onset.

The second assumption is that the torsion was already present before sufficient pain was experienced to attract the patient's attention to it. If that is true, any one of the factors enumerated as causing torsion of the cyst, such as straining, stretching, turning over in bed or any motion, might change the position of the cyst sufficiently to cause symptoms. According to this hypothesis, very little change in position would cause the occurrence of subjective complaints. In fact, once the condition had progressed to a certain point, it was irreversible and symptoms must ensue without regard to the acts or position of the host at the time they appeared. In other words, the pain was probably coincidental rather than the result of the alleged trauma. Aggravation of the existing pathology is the most that can be scientifically accepted.

MEDICAL DISCUSSION

Trauma causing torsion of the ovary must be divided into two types, direct and indirect. In the direct type, the injury is applied over or about the area involved. The exciting factor in the indirect type therefore includes all other types of trauma which might possibly cause torsion of the pedicle.

Direct violence has been accepted as a cause in many abdominal conditions, notably in peptic ulcer[70–78] and appendicitis.[1–19]

Where the diagnosis is accepted in these conditions, writers, both here and abroad, have insisted upon the following conditions:

1. The patient must have been in good health just prior to the accident.
2. No previous accident of a similar nature must have occurred.
3. There must be a definite history of trauma followed by pain, nausea and vomiting, which is progressive to the time of operation.

In cases of peptic ulcer and appendicitis, the trauma is understood to have caused an abrasion in the mucous membrane or an injury to the tissues which is demonstrable either grossly or microscopically. In cases of torsion of the ovary, overt injury to the ovary or its pedicle is not generally understood to be necessary, the trauma merely causing a twisting and not an abrasion or contusion.

In the seventh case listed in Table II there was in our opinion a contusion of the ovary with secondary torsion. We feel that in traumatic torsion of the pedicle caused by direct violence, injuries to the tissues grossly or microscopically evident are also a necessary concomitant. We believe that twisting of the pedicle in the manner that a

ball twists when struck on the side is not a satisfactory scientific medical explanation. We believe that the twisting occurs secondarily after interference with the circulation caused by the bruising and edema of the primary tissue according to the experiment of Payr.

Indirect violence is a vague term and scientifically is impossible to prove. Turning, twisting and indeed any act, normal as well as abnormal, may be so classified. The pathology found may be at a great distance from the site of the injury. The factors of predisposition, abnormal preëxisting pathology and a host of other questionable points are involved.

Indirect violence as a cause of peptic ulcer and appendicitis has been accepted by some writers, at least for medicolegal purposes. In these cases, however, injury to the tissues of the stomach and appendix is understood. Crohn and Gerendasy[72] state that peptic ulcer may be caused by violence in a distant part of the body. They explain this along the principles of contrecoup.

Shutkin and Wetzler[15] accept indirect trauma as a cause of appendicitis. They insist, however, that this be violent, acute, or unexpected.

Indirect trauma in cases of torsion of the ovary cannot be compared with peptic ulcer and appendicitis caused by indirect violence, since no definite injury to the tissues of the ovary or pedicle is understood.

The present writers, in surveying the subject, were struck by the similarity between torsion of the ovary[20–68] and torsion of the intestine or volvulus.[79–95] If we excluded all but cases involving the pelvic colon or sigmoid, we had an almost similar condition. A comparison of the etiology from the standpoint of trauma proved valuable. Both organs are in the pelvis and at the same anatomic level. In both, an unusual length of the mesentery (pedicle) and an abnormal mobility are considered essential for torsion. The etiologic factors are also similar. Tumors, mesenteric cysts, fecoliths, foreign bodies, pregnancy, constipation, direct violence and many other causes are given as the initiating factors in volvulus as well as in ovarian pedicle torsion.

In volvulus, as in torsion of the ovary, Sir Berkeley Moynihan[90] noted the tendency to recurrence. Richardson[92] stated that the rotation may be insufficient to cause intestinal obstruction, the condition causing recurring or chronic disability. Brenner stated that of twenty-eight cases, seventeen had previous symptoms caused by partial torsion. The torsion varied from 90 degrees to four complete turns. The analogy is therefore very close with the exception of intestinal obstruction, either partial or complete, in the case of volvulus.

Stoian, Tedorescu and Florescu[94] cited a case of acute volvulus following violent exertion. The patient had been in good health previously. There was, however, a loop of ileum strangulated in the anterior iliocecal fossa as well as the volvulus of the intestine.

Essau,[81] in 1875, von Bergman,[95] in 1900, and Garre,[84] in 1901, reported cases following severe muscular exertion.

Brenner[79] reported two cases of volvulus following direct trauma.

A comparison of volvulus and torsion of the ovary, however, is unfortunately of little assistance in finally determining the question of trauma as an etiologic factor. The same conditions and resulting torsion occur in both. The exact initiating factor, on the other hand, still remains unknown. Direct trauma as a cause must be accepted in both. In each, actual injury to the tissues is understood and the resulting pathology logically follows.

Indirect trauma in the case of torsion of the ovarian pedicle seems less logical than that of volvulus of the sigmoid. Peristalsis or movement is normally present in the sigmoid and an increased amount due to unusual or abnormal conditions can be understood to cause torsion. The ovarian pedicle on the contrary plays a passive role only. Twisting must be caused entirely by outside influences.

In direct traumatic torsion as in traumatic appendicitis, etc., the same postulates should hold: (1) previous good health; (2) no previous attack of a similar nature; and (3) a definite history of trauma followed by pain and progressive symptoms of torsion of the pedicle, leading to operation or death.

The conditions which will warrant the conclusion of torsion caused by indirect trauma cannot be definitely stated. From the literature and our own experience we feel that there is no such clinical entity as indirect violence initiating sufficient immediate torsion of the ovarian pedicle to give the pain syndrome demonstrated in the cases cited.

Indirect trauma as an aggravating factor in torsion which is already present does correspond with known facts. Consequently twisting, lifting, slipping and so on must be accepted as causes of indirect trauma, when aggravation is alleged.

DISCUSSION OF LEGAL PRINCIPLES

The purpose of the law is to award just and reasonable compensation "for the natural and proximate consequences of the wrongful act."[97]

The principle is substantially the same in industrial accidents. "Injury and personal injury mean only accidental injuries arising out of and in the course of employment and such disease or infection as may naturally and unavoidably result therefrom."[98] There must be a causal connection between the accident and the ultimate condition for which compensation is claimed. The connection, when proved, establishes liability not only for the immediate consequences of the injury but also, for all other conditions flowing unavoidably therefrom. It has been held, for example, that there was a sufficient causal relation between an accidental injury and death when it appeared that the deceased was suffering from a dormant disease which became activated and brought on such mental derangement that by his conduct he contracted diphtheria followed by pneumonia.[99]

It is also fundamental that an accidental injury need not be the sole cause of the ultimate condition. It is sufficient if it is established to be an operative contributing cause.[100] It has been decided, for example, that the amputation of a leg following traumatic infection to the foot was compensable even though it appeared that the claimant had an existing diabetic condition without which the infection probably would have been checked.[101]

Legal liability is not limited to the effect of an accidental injury upon a person in sound health. A dormant or existing condition which is activated, accelerated, or aggravated by an accident is also compensable.[102] "The negligent actor may be liable for harm to another although a physical condition of the other which is neither known or should be known to the actor makes the injury greater than that which the actor as a reasonable man should have foreseen as a probable result of his conduct."[103] In a recent New York case, for example, compensation was awarded for restriction in abduction and rotation of a shoulder and atrophy of the left upper arm although it appeared that the claimant had a dormant arthritic condition which was aggravated by the accident.[104]

It is apparent that the applicable principles of law in this field must necessarily be broad and general. In the final analysis, each case will depend upon its own facts. There is generally no difficulty. The causal connection is usually clear when credible evidence is offered of the accident, its severity, previous integrity of the wounded part (except when the claim is activation or aggravation), the appearance of symptoms sufficiently close to the injury as to warrant the inference of cause and effect, and identity of the injured area with the ultimate condition for which compensation is claimed.

It must also appear that the condition is one which can conceivably be caused by trauma. The decisive factor is of course, medical evidence. The difficulty is that the etiology of many conditions is either uncer-

tain or unknown. Nevertheless, the law in dealing with the facts of everyday life expects medicine to furnish an opinion which will do justice with as much certainty as is possible in the light of medical knowledge at the time.

Case I. In this case, an automobile in which the claimant was riding was struck by a train, causing direct injury to the abdomen with the appearance of symptoms immediately. The causal connection is clear. It is agreed that torsion of the ovary may be caused by direct trauma. It is not important from a legal standpoint whether the trauma caused the twisting immediately or secondarily. The decisive factor is that the torsion was the proximate consequence of the injury.

Case II. In this case, the claimant apparently suffered a strain in her right side while lifting a tray. Liability was accepted by the insurance carrier, apparently because sudden strains have been held to be accidents within the scope of the Workman's Compensation Law.[117]

The difficult question is whether there was any causal relation between the strain and torsion of the ovary. The question is obviously medical and not legal.

It seems clear that the strain by itself did not cause the twisting. Apparently, torsion was already present. The effect of the strain may have been to aggravate the condition. If that is true, the case was compensable under the principles of law stated above.

SUMMARY

1. Traumatic torsion of the ovarian pedicle is a distinct entity.

2. The mechanism of the direct type is scientifically logical and when found, evidence of injury, either gross or microscopic is present.

3. Indirect trauma cannot be accepted as the initiating cause of the condition but may aggravate a torsion which is already present.

4. Legal liability may rest upon either type of trauma.

5. From a legal standpoint, it is immaterial whether the trauma is the sole cause of the torsion or merely aggravates or accelerates an existing condition.

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TUBERCULOSIS OF THE BREAST

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THE subject of this paper appears at first glance to be of academic rather than practical interest, but a review of the literature shows that tuberculosis of the breast occurs frequently enough to deserve careful consideration in the diagnosis of mammary tumors.

Bloodgood found tuberculosis in 6 per cent of benign tumors of the breast. Gatewood reported it present in 1.04 per cent of all breast cases operated upon. At the Mayo Clinic, from 1904 to 1915, ten patients with tuberculosis of the breast represented 0.51 per cent of all mammary conditions admitted to the hospital. Barker tabulated sixty-two cases at the University Hospital at Ann Abor, showing a ratio of one case of tuberculosis to forty-five of malignancy. At St. Bartholomew's Hospital, London, in 1,500 cases of diseases of the breast, 1.5 per cent proved tuberculous.

A little over one hundred years ago (1829) Sir Astley Cooper first described the disease as "scrofulous swelling of the bosom." More than eighty years ago Heyfelder reported the first known case in a male patient. In 1868, Cuneo described another case in a male patient, and he was perhaps the first to isolate the organism from the pus and obtain positive results by animal inoculation.

Diagnosis by histologic examination, so far as is known, was first performed in 1860.

In the year 1881 new impetus was given the study of this disease as a distinct clinical entity by the work of Dubar, whose diagnosis rested not only on finding the tubercle in the tissue, but the bacillus as well.

There are a number of excellent articles on this subject in the literature, that by Maximilian Morgen being one of the most painstaking reviews, covering the period up to 1931. It is upon this paper that I have largely drawn.

There is no unanimity of opinion as to the mode of infection. Some authors believe that in the majority of cases the disease is of hematogenous origin; others that it is a retrograde lymphatic process. In a few rare instances there is no doubt that the entrance of infection was via the ducts, wounds in the skin, or by contiguity of tissue.

Nagaskima performed autopsies on thirty-four patients who died of miliary tuberculosis, in which the breast seemed to be the only organ that was spared; infection by the blood stream probably is not the usual method.

The most logical explanation seems to be a retrograde lymphatic involvement via the axillary, cervical or other lymph glands. There is, somewhere in the body, an unrecognized focus of tuberculosis. We all accept the dictum that "Many are infected with tuberculosis but not all are diseased." In confirmation of the belief in the retrograde lymphatic process, Deaver quoted the French surgeon Duvergey, whose patient, while washing the linens of tuberculous persons, injured one of her fingers and had a suppurating wound for two weeks; eight months later a swelling in the axilla was opened and drained but it did not heal; three months afterward a lump in the breast had to be drained; other sinuses developed; finally the lungs became involved; the Koch bacillus was isolated from the pus exuding from the breast.

In 1914, Deaver made an exhaustive study of seventy-four cases reported in the literature during the previous ten-year period. He found the tubercle bacillus only seven times in stained sections and only

four times in the pus from the necrotic areas.

It is exceedingly difficult to demonstrate the tubercle bacillus in the tissue or the discharge. Gatewood has given this point much study. In every instance in which he was able to isolate the organism it proved to be of the bovine type. We know that the bovine bacillus has a special predilection for lymphoid tissue; this too would strengthen the conviction that the organism enters the breast via the lymphatics rather than the blood stream.

In many cases the axillary glands are enlarged before a mass is recognized in the breast, and fully 50 per cent of the patients have palpable axillary lymph nodes when they consult their physicians.

In several instances carcinoma was found to coexist with tuberculosis, the microscopic study in some cases revealing carcinoma in the breast and tuberculosis in the axillary glands; in others the two pathologic processes were intermingled.

All investigators are satisfied that heredity has practically no part in the problem. Family history of tuberculosis is frequently negative in the primary type.

Trauma, though unquestionably an etiologic factor in a few rare instances, plays but a minor rôle.

Tuberculosis of the breast is, of course, most common in women, and appears most frequently between the ages of 20 and 50. Demme found tuberculosis in the breast of a male infant of six months. Carache, in 1934, reported a case in a woman 74 years of age. Gotthelf of Tucson recently told me of two cases, one in a male patient, both suffering from phthisis, the nature of the breast tumor in each instance being confirmed by histologic examination.

Altogether there are now over 500 cases reported in the literature, at least twenty of them in male patients.

Most of the women were in the childbearing age, and pregnancy and lactation are unquestionably important predisposing factors in the etiology. Out of 366 women with tuberculosis of the breast, 81 (or a little over 20 per cent) were single; of the total 366 women, half had given birth to children.

Clinically, most cases of tuberculosis of the breast belong to the so-called *primary* type—careful search for evidences of tuberculosis elsewhere in the body proves negative. These are often robust, healthy-looking individuals. The *secondary* type is found in patients with a distinct history or evidences of tuberculosis, either active or arrested. Naturally, such patients, as a rule, have only fair general health, or poor.

A lump in the breast is usually the main or only symptom which brings the patient to the physician; she has observed it on an average of six months; sometimes it has existed for years but has only recently become active. Out of 439 cases reviewed by Morgen 132 noticed the lump for six months or less; ninety-seven for more than six months; one for as long as eight years, and another for fourteen years.

Swelling of the axillary glands is present in about half of the cases. Often it is the only abnormality observed by the patient.

Pain is not an early symptom but always sets in when the tumor has grown to sufficient size to stretch the skin, or has broken down.

A lump in the breast may remain quiescent for many years, but once it becomes an active tuberculous process it pursues a progressive course. It has never been known to undergo spontaneous retrogression. Naturally, in the lactating breast it would assume its most fulminant form.

A number of pathologic classifications have been arranged by the different writers on this subject, but about 90 per cent of the tuberculous tumors of the breast can be grouped under three headings:

1. Nodular Variety.

   The breast itself is not necessarily enlarged, but contains one or more firm masses which rarely exceed the size of a hen's egg, and feel like adenomata. This is the most common form.

II. Confluent Variety.

This is a further step in the pathologic process, which assumes a more acute form, and is frequently seen in the lactating breast. The separate nodules have broken down and fused together. Pain develops because of the distention, and the overlying skin becomes tense and red and finally breaks down, releasing a cheesy, purulent discharge. Numerous sinuses may form, each originating in a separate caseating area, or the tracts may communicate with one another.

The cold abscess of Roux belongs to the confluent variety—deeply seated behind the breast tissues where it cannot break through but may gradually burrow its way to the surface.

Fixation of the skin is common in those broken down nodules which lie close to the surface.

Retraction of the nipple ensues when the process is located behind the areola.

III. Scirrhous Variety.

This is most frequently found in elderly women, and is analogous to fibroid phthisis. It resembles scirrhous carcinoma.

The breast is shrunken, distorted and adherent to the chest wall, the nipple retracted, the skin fixed. The pathologic process spreads rapidly to the glands of the axilla, which often break down even though the breast itself remains stationary.

In the gross pathology the nodule often presents a translucent, grayish appearance at the periphery, which fuses into the surrounding tissue; it does not cut with the gritty sensation so typical of malignancy. The center is waxy in appearance and may be necrotic.

Microscopically, it is composed of giant cells of the Langhans type, epithelioid and lymphoid cells, and the usual structures characteristic of tuberculous tissue.

In the 439 cases which Morgen tabulated, fifteen were also carcinomatous; in five adenomata were likewise present; a number showed fibroadenomata. Tuberculosis and carcinoma of the breast may be independent of each other, simultaneous or consecutive. Tuberculosis may be engrafted upon a malignant growth, or carcinoma result from the chronic irritation of the tuberculous process.

The big problem of tuberculosis of the breast lies in its diagnosis, which is exceedingly difficult, especially in its most frequent form—the primary, nodular type—and is usually not made until the time of operation, and much more often only after an operation for supposed carcinoma is completed.

A lump in the breast with palpable axillary glands usually spells carcinoma, and the common treatment by radical mastectomy is indicated. Even if it should prove to be tuberculosis, that too is a disease which threatens life, so that heroic measures are most certainly justified.

If the patient be a woman past 50, perhaps it makes little difference whether a radical or a simple operation has been performed. However, many of the victims of tuberculosis of the breast are women in the twenties and thirties, and it is highly desirable to spare them the mutilation of a radical mastectomy. This may in time result in considerable deformity and even handicap them seriously through partial or total disability of the arm. This point is particularly worthy of emphasis in view of the fact that women will more and more seek medical advice early, when the diagnosis is most difficult.

A positive clinical diagnosis of mammary tuberculosis cannot always be made. There may be a single painless lump with the overlying skin showing the pigskin appearance of carcinoma; an unruptured abscess without inflammatory phenomena, resembling a cyst; discharging sinuses indicating a pyogenic mastitis, broken down carci-

noma or gumma; and the sclerosing type, occurring in the cancer age and much more likely to be diagnosed as malignant.

When a dependable history can be obtained of axillary adenitis preceding by some months the appearance of the lump in the breast, we have a valuable clue to the possible pathology.

In acute or infectious mammary tumors an abscess of the lactating breast is so likely to be regarded as an ordinary pyogenic infection that the true diagnosis is perhaps less frequently made in such cases than in any other form of the disease. As a rule these apparently simple abscesses are opened and drained. The wound heals only to break down later, before the real nature of the infection is determined. Blisnjanska, Lasarevitch and Triousse studied 124 infants born of mothers with open tuberculosis and demonstrated the presence of the tubercle bacillus in the milk of many of these women.

A mammary tumor with sinuses would, of course, arouse our suspicion as to possible tuberculosis, and a biopsy would establish the diagnosis and lead to conservative surgery; for, as one author puts it: "There is practically never any necessity for a radical mastectomy in tuberculosis of the breast."

X-ray of the breast differentiates between the sharply defined cyst-like mass and that which radiates into the surrounding tissue. Lee and Floyd of Philadelphia found in one of their cases of suspected carcinoma the typical diffuse mass which left no doubt as to the malignant nature of the growth. The removed breast showed tubercles. On reviewing the film they recognized a base line, about ½ inch from the chest wall, which, as they state, should have made them think of a non-malignant neoplasm.

In the differential diagnosis, carcinoma outweighs all other conditions in importance. Especially is this true because the nodular variety is the kind most frequently encountered. This is usually operated upon for cancer.

Stuart W. Harrington of the Mayo Clinic emphasizes some excellent points in his paper on the subject: "In the discrete type of tuberculosis of the breast there is often associated adenopathy and fixation of the lesion to the overlying skin; often there is no pain. Some features, however, if present lead to the suspicion that the lesion is tuberculous. Usually mammary tuberculosis afflicts young women and the tumor increases in size more rapidly than a carcinoma. Although a tuberculous tumor of the breast is large when the patient presents herself for examination, metastasis is absent; if such a large growth were malignant, extensive metastasis would be demonstrable by roentgenologic examination. Discharge from the nipple is more commonly a feature of tuberculous than of carcinomatous lesions, and the discharge from a tuberculous lesion is usually composed of pus-like material whereas that from a carcinoma is serous or bloody."

Sarcoma of the breast is exceedingly rare; it grows very rapidly, the cutaneous veins are greatly distended, and pain is intense.

In actinomycosis there would be a history of trauma and the finding of the sulfur granules and the Ray fungus; in tuberculosis the discharge may or may not contain the Koch bacillus, but the tissue would show the tubercle.

Gumma of the breast cannot be diagnosed by a serologic test. McGehee and Schmeisser reported eight cases of tuberculosis of the breast, in 1935, three of which showed positive Wassermann reactions. This did not deter them from operating. One woman with a four plus Wassermann, had noticed a lump in the breast for eight months. The cervical and axillary lymph nodes had been involved but the enlargement disappeared three months previously. A radical operation for carcinoma was performed. The tissue under the microscope presented miliary and conglomerate tubercles.

Wilson reported a case in a woman of 62 who for two years had felt multiple small

tumors in her left breast, which now had attained twice its normal size. The first physician had a biopsy and a Wassermann made, and informed her the growth was syphillitic. Under a course of sixteen arsphenamine treatments she grew steadily worse. The surgeon who saw her next diagnosed malignancy, but, because her condition seemed so hopeless on account of an incompetent heart, he advised against surgery and recommended that she enter a hospital to be made comfortable until the end. Digitalization and rest accomplished unexpected improvement in her general health, so that the mass of supraclavicular glands could be removed. The pathologist reported: "Typical proliferative tuberculous adenitis; no evidence of malignancy or gumma."

After all is said and done tuberculosis of the breast is a baffling problem, and not so uncommon as we are prone to think. Biopsy is the only dependable method by which it can be diagnosed prior to operation; the frozen section, when surgery is undertaken without previous histologic investigation, will determine the nature of the tumor—it will at least disclose the fact that it is non-malignant.

The prognosis is good in the primary type if recognized early and eradicated by proper surgical means. Once tuberculosis of the breast becomes active, however, it usually pursues a more rapid course than carcinoma. Left to itself it advances through extension, particularly into the thoracic viscera, until death ensues. Vandel stated that the average duration of the disease, without intervention, varied from ten months in the primary cases to between eleven and twelve months in the secondary cases.

In the secondary type prognosis as well as treatment depends on the patient's general health and the original infection. With the extensive surgery for the treatment of pulmonary tuberculosis so successfully developed during the past few years, we are unquestionably opening wide the channels of the superficial thoracic lymphatic system, and it would not be surprising if in the future a much larger percentage of the secondary type of tuberculosis of the breast came to our notice.

Amputation of the breast, followed by heliotherapy or roentgenotherapy may make the patient more comfortable in the less hopeful cases.

Treatment, of course, is always surgical in the primary cases and since the latter part of the nineteenth century it has been the generally accepted method. Opening and draining tuberculous abscesses of the breast, scraping or cauterizing fistulous tracts, were methods in vogue before the histologic examination of the tissue was extensively practiced and in the era preceding Koch's discovery of the tubercle bacillus. To employ such measures now is merely to invite disaster.

Some of our leading surgeons recommend preoperative radiation, excision with the cautery knife, and postoperative radiation. Some amputate the diseased breast and dissect out the lymph nodes; others amputate only the breast and treat the glands by *x*-ray; a few men always do radical operations; most prefer the conservative operation. Rest in the country for some months following surgery is an important feature in the after treatment of some authors; two mention the use of tuberculin ointment and quartz light therapy in early cases, instead of surgery. Efficient treatment by mastectomy, however, is practically universal, and is the only safe and satisfactory method.

SUMMARY

1. Tuberculosis of the breast occurs more frequently than is generally supposed.

2. In a high percentage of cases the patients are young women under 40 years of age.

3. Once it becomes active it pursues a rapidly fatal course.

4. Biopsy offers the only dependable method for accurate diagnosis.

5. Frozen section at the time of operation occasionally shows typical findings of tuberculosis; but it always proves the growth to be non-malignant.

6. Simple mastectomy is the operation of choice, and if performed early makes the prognosis favorable.

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MERTHIOLATE: A TISSUE PRESERVATIVE AND ANTISEPTIC

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I HAVE found clinically and experimentally in the past five years that merthiolate (Lilly), both the tincture and the aqueous solution, is a most efficient and highly satisfactory preservative and antiseptic in reconstruction surgery. I use this product practically exclusively in preoperative preparation in all types of skin grafts and other plastic problems. The antiseptic qualities of merthiolate,[1] although of secondary consideration in this report, strengthens its value as a preservative agent. The preservative action has been studied along other lines,[2] but I am particularly concerned here with the use of merthiolate in the preservation of what I call "refrigerated cartilage isografts."

These grafts are used to reconstruct all facial appendages and repair contour defects of the forehead, nose, ear, chin, eyesocket and other parts of the facial framework. The cartilage, mainly rib, is obtained under sterile or unsterile conditions and is stripped of its perichondrium. It is then thoroughly washed with ordinary tap water to remove any blood which may have collected. It is then placed in a sterile glass container and covered with a solution of one part aqueous merthiolate (1:1000) to four parts of sterile normal saline. The solution should completely cover all of the cartilage by an excess of at least 1 inch. The container is covered and placed in the refrigerator. It is taken out only when the solution has to be changed or cultured, or the refrigerated cartilage is to be used for grafting purposes. When new cartilage material is prepared, the solution is drained off and changed twice a week for two weeks and once a week thereafter. New cartilage material should not be added to the sterile original container unless it has undergone the "merthiosaline" treatment for at least one week and two cultures of the second preservative solution are negative. I have made it a routine to obtain a culture from the "merthiosaline" solution every time a piece of refrigerated cartilage is to be used for reconstruction. There has never been a positive culture return from the preservative solution in over 375 cases.

I have used refrigerated cartilage isografts as early as twenty-four hours and as late as two years after they have been placed in the "merthiosaline," but I strongly advise that this type of graft not be used until it has been refrigerated in the solution for at least one week and until negative cultures of the solution are obtained by the operator. Refrigerated cartilage isografts that have been preserved over six months are just as efficient as fresh cartilage. The long waiting period, although not advisable, does not materially affect the cartilage as grafts.

Macroscopically the fresh and older cartilage is identical, except that some of the older material is slightly more pliable than when first obtained. Microscopically small vacuoles occasionally were noted in the sectioned cartilage. Refrigerated cartilage isografts, when transplanted, bend occasionally, but with much less frequency than autografts. This is probably due to the fact that when the perichondrium is removed and the cartilage is placed in the "merthiosaline" it assumes the shape that the internal strains and stresses of the cartilage cells dictate. Grafts can then be sculptured from this cartilage of the required shape to fit the existing defect. Cartilage isografts have been accurately

sculptured and then placed in the "merthiosaline," which sterilized and preserved the graft until it was ready for use.

In 375 transplants, local infection developed in six cases, mainly in grafts for reconstruction of the nasal bridge or tip. These infections responded to local treatment. All the grafts remained in situ except for any portion which became exposed; the exposed portion of the graft was gradually digested or was surgically excised to speed up wound closure. The latter was the usual procedure as it materially shortened the period of postoperative care.

If a refrigerated cartilage isograft becomes infected there are several alternative procedures possible. The whole cartilage graft may be removed immediately, after which the infection subsides rapidly and the wound heals in a short time. If good dependent drainage is established the graft can be left in situ and it will survive, but healing is delayed. To speed recovery where nasal bridge transplants became contaminated, I established intranasal or columellar drainage points and grafts were irrigated with "merthiosaline" introduced through the nasal skin into the graft bed by hypodermic syringes. This should not be done under pressure, and only when through and through drainage has been established. The solution merely acts as an irrigant, injected into the graft cavity and not the skin or subcutaneous tissue.

One total graft was removed; it was taken out, due to streptococcus infection, through its point of introduction, forty-eight hours after being placed under the skin of the nasal bridge. The symptoms subsided under local treatment as soon as the graft was removed and adequate drainage provided. This infected graft was thoroughly washed in saline solution, refrigerated in the "merthiosaline" and kept for six months. It was then felt that the site to be grafted had recovered from its infection and the original graft was reintroduced. Healing occurred per primam. Infected cartilage can be removed, resterilized, preserved in "merthiosaline" and used again.

After a five year waiting period all but seven of the transplanted refrigerated cartilage isografts have retained their original size and identity. Parts of six grafts became exposed and one small nasal bridge graft was entirely absorbed.

The one graft that completely absorbed was 7/8 inch long, 2/8 inch high and 3/8 inch wide. It was used to build up a luetic nose which was noticeably lacking in skin covering and mucosal lining. The graft was unfavorably situated under tension and an opening occurred between it and the nasal cavity. The continued mild infection plus the exposure of the graft eventually caused its disappearance. An additional refrigerated cartilage isograft was inserted after a six month waiting period and has remained in situ for three years.

My methods, technique and results have been presented to others in communications, and many have used this type of graft with success.

COMMENTS

1. After five years' experience I feel that merthiolate has proved a highly satisfactory antiseptic and preservative for cartilage isografts.

2. Refrigerated cartilage isografts have been successfully preserved and utilized as contour building material as late as two years after preservation.

3. The cartilage grafts are not materially changed by their preservation and maintain their identity indefinitely after grafting.

4. Refrigerated cartilage isografts are most efficient, highly satisfactory and economical for the patient.

5. In my work refrigerated cartilage isografts have entirely replaced the autogenous cartilage graft which previous to this experimental work had been our choice of grafts for certain types of contour restoration.

I express my sincere appreciation to Dr. A. Moody and Dr. S. Leland of San Francisco for the cooperation and assistance they have rendered in helping to solve the many problems that confronted me in this work.

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The modern tendency is to look upon non-tuberculous renal infection as a single pathologic entity presenting various types, dependent on the location and bacterial type and cause of the original lesion, on the course of its evolution and on the extent of tissue destruction that has been sustained.

From—"Manual of Urology" by R. M. LeComte (Williams & Wilkins).

CASE REPORTS

FAMILIAL OSTEOPOIKILOSIS*

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Definition. A rare, familial disease characterized by multiple areas of condensation in the epiphyses and metaphyses of bones. These areas vary in size and shape. They may be spherical, elongated, lenticular, or striated in character. The striated or ray type never extends into the ephiphyses proper but seems to stop abruptly at the epiphyseal line.

Synonyms. This disease has been wrongly called osteosclerosis fragilis generalisata. Osteitis condensans generalisata has been used, but the disease is evidently not of an inflammatory nature. It was called osteopoecilia by Chabaneix and Dessane. Newcomet thought the disease was a multiple enostosis and called it spotted bones. Wachtel named it osteopathia condensans disseminata.

Etiology. The exact cause of osteopolkilosis is unknown. A number of diseases have been found coexisting with this condition and have been thought by some to play a part in its origin. Svad[1] reports a number of cases with a concurrent diabetes. Shinz, Baensch and Friedl[2] think that it is a maldevelopment probably arising by a mutation and recurring recessively. Konig,[3] Wachtel,[4] Steenhuis,[5] and Moreau[6] advanced the theory that it was due to emboli in the terminal arteries. Wilcox[7] thought that it was due to more or less uniform disturbance in proliferation and ossification of bone forming cartilage during the period of development. Newcomet[8] thought the condition was due to multiple enostosis extending into the bone from the periosteum. Ledoux-Lebard, Chabaneix and Dessane[9] found a history of typhoid in their cases. Schmorl[10] described the condition as being hereditary, possibly related to a parathyroid disturbance. There is no conclusive evidence that shows any relation between the condition and any infectious disease as no one disease has been present in all cases. Nichols and Shifflet[11] thought it was due to an abnormal relationship between osteoclasts and osteoblasts. Voorhoeve[12] thought that it was related to chondrodysplasia.

There is some evidence that the condition may be related to the arterial system as the general distribution follows that of hematogenous tuberculosis in the bone. However, this is far from proved. The fact that it is scattered throughout the metaphyses and epiphyses, with no direct relation to the epiphyseal line, would tend to disprove any connection with cartilaginous bone formation. The idea of these areas being enostosic would be disproved by the fact that they were not in contact with the cortical bone as they would be were this true. In one of my cases definite cystic areas were found in the cortex of the metatarsal bones with a very condensed area immediately surrounding. These areas bulged externally and internally from the cortex. This condition has not been previously noted in osteopoecilia. There can be no doubt as to the cortical location of these areas, and furthermore they are about the size of cancellous bone lesions found elsewhere.

*Plates and films by W. L. Gerald.

Age, Incidence and Distribution. The youngest patient reported is in a case of Heilborn,[13] in a fetus of 4 months. An occasional case has been found in infancy and childhood, but most instances are found between the ages of 15 and 60.

To date about seventy-two cases have been reported in the literature, the greater number in Europe. About ten articles have appeared in the United States. The present report covers seven cases in one family.

These lesions have been reported in practically every bone in the body with the exception of the skull; in one instance they were found in the occipital bone. In a large number of cases they are absent from the pelvis and vertebrae. They seem to have a predilection for the epiphyses and metaphyses of the long bones, being most frequently found in the small bones of the wrist, the hands and the feet. The small, rounded lesions are generally found in the epiphyses but may be found in the metaphyses. The linear lesions are practically never found in the epiphyses and are found in the cancellous bone. Changes in the external lines of the bone have not been noted before.

The occurrence of the bony lesions in eight members of one family certainly goes a long way to prove the hereditary tendency of the disease. It is expecting too much of coincidence to have such a rare condition show up in so many cases in the same family.

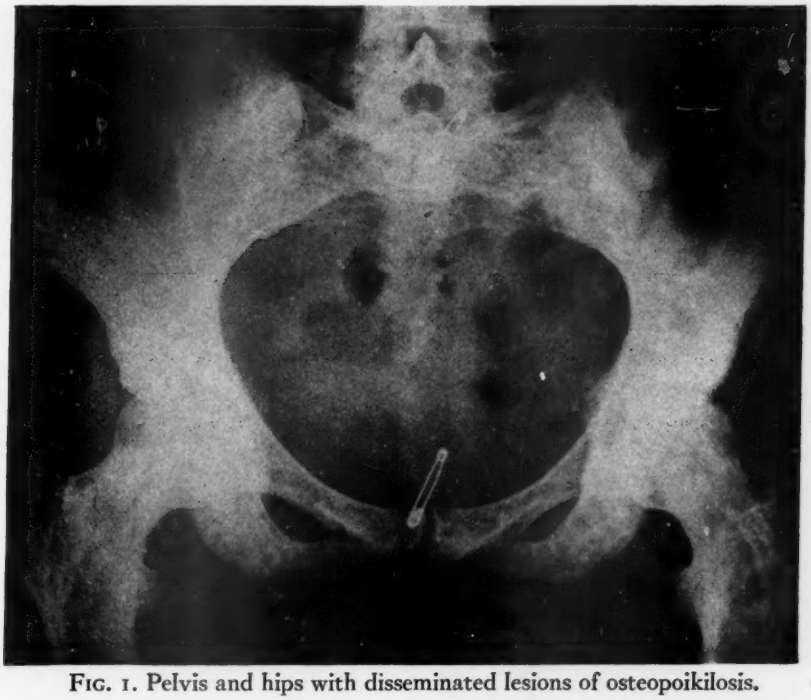

Fig. 1. Pelvis and hips with disseminated lesions of osteopoikilosis.

The disease was first reported by Stiede[14] in 1905. The next case reported was that by Albers-Schonberg[15] in 1915; next, Ledoux-Lebard[9] in 1913, Moreau[6] in 1916, Wachtel[4] in 1923, Richarz[16] in 1922, Schele[17] in 1922, Voorhoeve[12] in 1924, Steenhuis[5] in 1926, Buschke-Ollendorf[18] in 1928, Van Dorp and Beucker[19] in 1928, Gluch[20] in 1929. The first case reported in this country was that by Newcomet[8] in 1929. Amundsen[21] reported a case in 1930, Guelliars and Mollaret[22] in 1930, Awalischwili[23] in 1930, Konig[3] in 1930, Schmorl[10] in 1931, Reiser[24] in 1930, Haack[25] in 1931, Van Pee[26] in 1931, Wilcox[7] in 1931, Windholz[27] in 1932, Bloom[28] in 1933, Holly[29] in 1936, Nichols and Shifflet[11] in 1934, Bach[30] in 1931, Mascherpa[31] in 1931, Nather[32] in 1936, Hirsch[33] in 1935, Sutherland[34] in 1935, Kadrnka and Hirlemall[35] in 1933, and Jeter and McGeehee[36] in 1933.

Voorhoeve[12] found the condition occurring in the father, brother and sister; Wilcox[7] in the father and daughter. Bloom[28]

FIG. 2. Large number of lesions, elongated, circular and lenticular, in the femur, patella and tibia.

reported an isolated spot in the sister of his patient.

Symptoms. Osteopoikilosis is apparently asymptomatic, generally being found during roentgenographic study for some other lesion. In most instances the discovery of the disease in one region of the body leads to further study of the entire body. In some instances, as in my cases, the patients have complained of indefinite pains in the back and thighs, and in the two cases of the ray type hydrarthrosis of the knee had been present. Windholz[27] and others report the presence of a disseminated lenticular dermatofibrosis in their case. This is characterized by slightly elevated papules in various parts of the body usually close to each other. They are oblong or oval-shaped, about the size of a lentil, and may be longitudinal stripes.

There is a fibromatous thickening of the cutis without tumor formation. The elastic fibers are usually well preserved within

FIG. 3. Cortical nature of lesions in third metatarsal bones.

these areas. Some authors believe that the bony and skin changes are both a part of a constitutional anomaly of connective tissue. Others believe it to be similar to scleroderma.

The occurrence of osteopoikilosis along with congenital syphilis, tuberculosis, and various bony changes of other types has been mentioned. The lesions are usually bilateral in character but are often missing from some bones. The nodules are very dense in comparison with surrounding trabeculae and vary in size from 1 to 4 cm. Some authors have followed them over a period of years and have noted no change in the size and number of islands.[8] Holly,[29] however, states that in four cases which he followed for five years a definite change occurred in the islands of condensation. Some entirely disappeared and many of the lesions became enlarged, especially those in children. In some instances he noticed fusion of two or more areas. Some became

smaller and there was fading of some of the larger spots. Some of the round nodules became elongated and many coalesced. While the lesions are usually distinct from the surrounding bone, some gradually fade away into what appears to be normal spongiosa.

There is no increased fragility in these bones and though a number of cases have been followed carefully, no constant changes have been noted in the blood counts or blood chemistry. In a few cases there were changes in the calcium and phosphorus content of the blood, but this was not constant enough to be significant.

Differential Diagnosis. Osteopoikilosis must be differentiated from carcinoma, sarcoma, syphilis, osteomyelitis, tuberculosis and typhoid bacillus infection.

In bone forming carcinomatous metastasis the differential diagnosis is hard unless the entire skeleton is examined. However, a careful search for a primary lesion and *x*-ray examination of the entire skeleton will generally reveal the difference.

The changes seen in sarcoma, syphilis, osteomyelitis, typhoid and tuberculosis are quite distinct and should give no trouble in differentiation. The clear, distinct nature of the nodules and their distribution should result in early diagnosis if the condition is kept in mind. Some difficulty may be encountered in cases of osteopoikilosis concomitant with these diseases.

Melorheostosis of Leri must also be differentiated. This usually is diagnosed by the hyperostotic processes always limited to one extremity. The direction of growth here is characterized by considerable striated density of the bone but extends from the flat bone of the root of the extremity to the terminal phalanges. This gives rise to clinical symptoms such as pain and limitation of motion.

Pathology. Two cases have come to necropsy study. Schmorl[10] in 1931 performed an autopsy on a patient with osteopoikilosis. Death was due to widespread osteomyelitis with amyloidosis and destructive luxations and contractions of many joints. Hemolytic streptococci and proteus organisms were found in the purulent exudate. This patient had extensive calculus formation in both suprarenals and in the wall of an abscess around the left kidney. *X*-ray examination showed the disseminated osteopoikilie in all parts of the skeleton except the clavicle, vertebrae and skull.

Fig. 4. Multiple lesions around the shoulder joint.

On microscopic examination the bone foci, which on *x*-ray and visual examination appeared to be made up of compact bone, appeared dissimilar to the tissues corresponding to the compacta of the shaft bones. These foci consisted of spongy bone similar to the spongiosa. The bony trabeculae were thicker than the normal spongiosa trabeculae and plates otherwise present in that location. The individual trabeculae, of which the foci were composed, lay very close together and were thicker; therefore on inspection of the foci the impression of a compact bone island was obtained. On serial section the foci faded into the normal spongiosa and were connected with it in such a way that the spongiosa trabeculae were adjusted to their surface without a demonstrable sharp boundary.

Normal bony trabeculae may be found adjoining the surface of the foci. Besides bony trabeculae with a lamellar structure there are others, especially thinner ones, which are composed of fine, fibrillar bone tissue. The bone corpuscles contained within are often rather large as are found in newly developed connective tissue bone. Schmorl[10] stated that no reliable verdict as to the genesis of these trabeculae could be derived on the basis of microscopic examination. He felt that the theory of enchondral bone growth could not explain them as they were not found in the areas

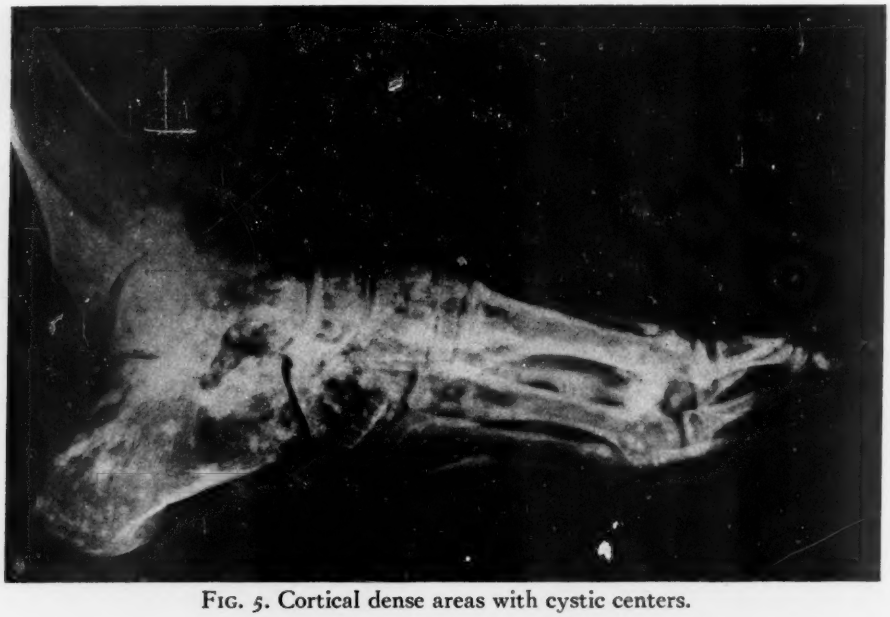

FIG. 5. Cortical dense areas with cystic centers.

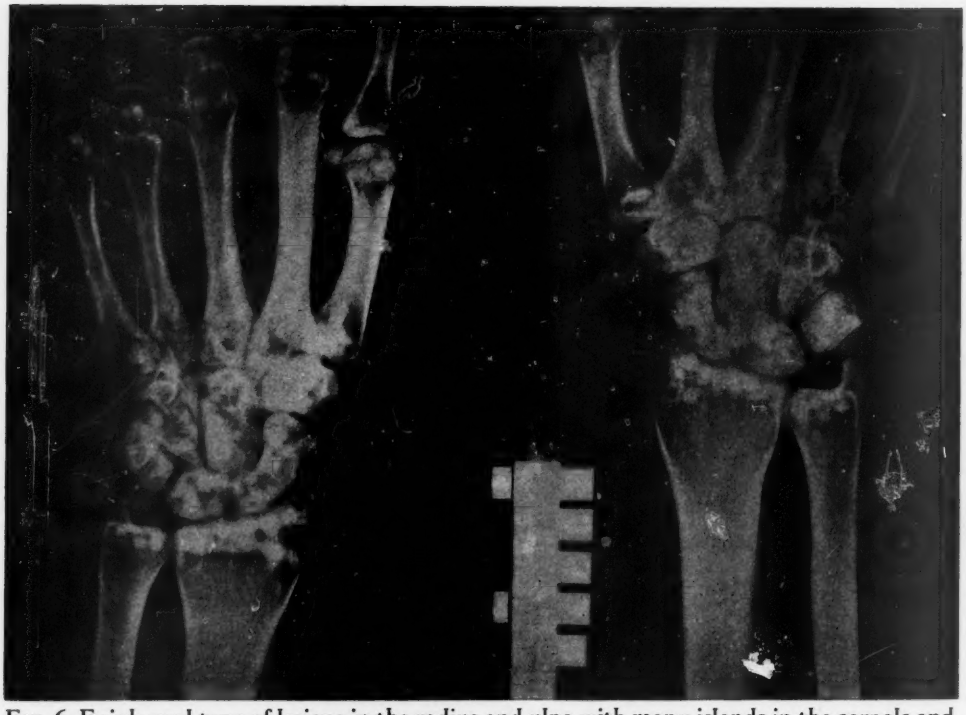

FIG. 6. Epiphyseal type of lesions in the radius and ulna with many islands in the carpals and metacarpal bones.

where this type of growth generally takes place. No cartilaginous remnants could be found anywhere in the tissue examined.

Fig. 7. Typical appearance of knee joints.

The pathology of the case reported by Windholz[27] was that of thickened trabeculae in the vicinity of the bone island. The focus consisted of closely arranged trabeculae with no sharp line of demarcation between normal bone and island. Fine vessels were found entering into formation between spaces of separate bundles of spongiosa. Small medullary spaces were found between trabeculae. The trabeculae were not parallel to the surface of formation but were radiating and had a rather perpendicular direction. A rather important observation here was the absence of osteoblasts. Osteoclasts were noted. No Haversian systems were present. There was no difference between the compacta and the normal bone in either case here, nor any signs of inflammatory reaction.

DISCUSSION

Osteopoikilosis is a rare familial bony change. Beyond this it is hard to make any definite statement. The literature is full of contradictory conclusions obviously based on an inadequate number of cases. The condition is apparently asymptomatic. It has occurred with periostitis, osteomas, chondromas, and syphilis, both congenital and acquired. It has been reported with tuberculosis, diabetes and disseminated lenticular dermatofibrosis. The diagnosis is easy if it is kept in mind. The pathology is apparently a localized overgrowth of the normal bony structure. Why it assumes the patterns seen is unknown. Possibly it is due to some congenital anomaly of the terminal arteries activated by glandular dyscrasia, an "acromegaly" of discrete islands of bone. Holly's[29] cases disprove the idea that the islands do not change in shape or size. My first case shows definite islands in the cortical bone with bulging of the normally smooth line of the shaft.

The ray type has not been examined pathologically. It is such a rare, bizarre condition that we should see further cases before stating that it is osteopoikilosis.

It is only by reporting these cases as they occur that definite conclusions as to their significance may be drawn.

CASE REPORTS

Case I. G. R., age 38, white, single, was admitted to the hospital on December 29, 1937 with a complaint of "rheumatic" pains along the right sciatic nerve. She had had previous attacks of sciatica ten years before. She was in bed for six weeks before admission and could not walk without extreme pain along the course of the right sciatic nerve.

Family history showed no evidence of tuberculosis, cancer, hemophilia or mental disease. The only fracture that occurred in the immediate family was in the mother who was 65 years old. This had occurred forty years before and had healed normally.

The patient had had measles, influenza, rheumatism, whooping cough, tonsillitis and grippe. Her tonsils were removed in November, 1937. She complained of an occasional headache and had a poor appetite.

Menstruation had begun at the age of 12, regularly occurred every twenty-eight days, for five days and was not painful.

General examination revealed a thin, white, undernourished female, height 5 feet 8 inches, weight 118 pounds, pulse rate 90, blood pressure 135/80. Behavior was normal. Careful examination of the eyes, ears, nose and throat was negative except for the absent tonsils. The thyroid gland was not enlarged. The breasts were slightly atrophic. The cardiovascular and respiratory systems were apparently normal. The abdomen was flat and contained no masses. No herniae were present. Pelvic examination showed an intact hymen which prevented a vaginal examination. Palpation by rectum showed the uterus to be in normal position with no adnexal pathology.

The patient complained of tenderness over the course of the sciatic nerve from where it left the pelvis on the right down to the popliteal space. Lesage's sign was positive.

The urine showed a specific gravity of 1.014, was amber in color and acid in reaction. Albumin, two plus, was found. Microscopic examination showed about 80 pus cells. Red blood count was 4,250,000, hemoglobin 88 per cent, white blood count 7,500, with polys 70 per cent, lymphocytes 24 per cent, and monocytes 6 per cent. Sedimentation rate was over three hours. The blood sugar was 116, blood calcium 8.7, uric acid 3.1. The Kahn test was negative. Examination of a vaginal smear was negative for gonococcus and trichomonas vaginalis.

X-ray of the lumbar spine and pelvis showed multiple areas of condensation of the spine, hips and pelvic bones. These areas were from 1 to 3 mm. in diameter and were closely divided from the surrounding apparently normal bones. They did not occur in the cortex, but in the spinous process and portions of the bodies of the vertebrae. The largest number occurred near the joint surfaces. There were several elongated areas in the metaphyses of the femora.

These findings led to a complete study of the skeletal structure. The same disseminated areas were found in the shoulders, knees, ankles and feet. The skull was negative. In the metatarsals definite areas were found in the cortex of the bone. Some were smooth spheroids projecting outward and inward from the normal cortex. The distinct, smooth outline would tend to disprove an inflammatory origin. Some of these dense areas in the cortex had irregularly cylindrical clear areas for centers, with dense island bone outside. These areas were not much larger than the normal islands of osteopoecilia.

Case II. M. G. R., mother of the first patient, age 65, had had nine children. She had always been in good health and had had no serious illness.

X-ray showed circular nodules in the small bones of the wrist, metacarpals and phalanges.

Case III. F. M. T., sister of the first patient, age 39 had no history of illness or broken bone.

X-ray of the wrist showed a moderate involvement with the circular type of lesion of the lower end of the radius and ulna, the small bones of the wrist, the metacarpals and the phalangeal bones.

Case IV. R. G. R., a brother of Case 1, age 44, had a negative past history except for meningitis in 1919 at which time he lost three toes, apparently from a gangrenous process. No other serious illness had occurred.

X-ray of the pelvis, lower spine and hips showed the typical disseminated character of the osteopoikilosis, particularly marked in the hips, the neck and trochanters of the femora and the pubic bones. *X*-ray of the wrists, hands and feet showed the same process in practically all the bones.

Case V. C. R., another brother, age 22, had had a broken finger in a football game several years before, and an appendectomy.

X-ray of the wrist showed very large, discrete condensations of the lower ends of the radius

and ulna, the small bones of the wrist, the metacarpals and phalangeal bones.

Case VI. V. W., a sister, age 30, had had an appendectomy eight years before, but no other serious illness.

X-ray of the pelvis, hips, lumbar spine, shoulders and feet showed the typical circular, lenticular and elongated lesions of osteopioikilosis, especially marked in the epiphyses.

Case VII. L. R., a sister, age 40, had had no serious illness.

X-ray of the wrists and hands showed one small area of osteopiokilosis in the lower end of the radius on the left.

Case VIII. N. M. R., a niece of the first patient, age 14, had a negative past history except for tonsillectomy.

X-ray of the wrist, hand, pelvis, hips, ankle and foot showed many disseminated lesions of osteopoikilosis in all these areas.

Two nephews and another sister of Case 1 were examined, but proved negative for osteopioikilosis.

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PLICATION OF THE SMALL INTESTINE

SECOND REPORT

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IN THE AMERICAN JOURNAL OF SURGERY of January 1937, under the title "Plication of the Small Intestine as Prophylaxis Against Adhesions" the first description of the uses of plication appeared and the method was described in its simplest form. It was believed at the time that understanding of plication in a single unit would naturally suggest its application in a more complicated form. Many contacts resulting from the publication of the above article have proved the correctness of this belief. A description of a more complex use of plication has seemed warranted therefore, particularly with reference to its use in a serious type of appendicitis.

When the acutely inflamed appendix lies low and in the pelvis surrounded by loops of small bowel, rupture means widespread peritonitis, sepsis, abscesses in mesenteric folds, multiple areas of constricted gut, intestinal obstruction, and a high percentage of fatality. Distention is met early and is perhaps the most active factor in an unfavorable outcome. Enterostomy has seemed the only hope; but the underlying pathologic state composed of constricted gut and thrombophlebitis of mesenteric vessels, abscesses in mesenteric folds, and infection under tension have all too often meant death from sepsis even though distention has been relieved through enterostomy.

For a number of years we have followed a plan more aggressive than that of so-called symptomatic treatment, which in this case consists of following after the developing and unimpeded pathologic state. In these cases of ruptured appendix with widespread peritonitis, we first do an appendectomy through a small McBurney incision leaving a rubber tube drain—not a Penrose—into the bottom of the pelvis. This may be done under novocaine or any gas-oxygen combination as fits the needs of the case. Postoperatively, as little morphine as possible is given, because of its depressing effect upon metabolism and probably upon liver function.

Surgical pituitrin is given, one ampule hourly or as needed, to prevent distention. This is instituted immediately after the appendectomy. Any sudden fall of temperature means that tolerance has been passed and that the pituitrin should be reduced or skipped for two or more hours, or replaced with pitressin for a short time. Intravenous glucose and liquid diet supply all nutrition until the outcome is decided by second operation, recovery, or failure. If distention can be kept down for two or three weeks, the outcome becomes more certain. Immunity must be developed and an accurate measure of this may be had from the clinical appearance and from the disappearance of nausea and the beginning of hunger. Observation has taught us that no accurate picture of the extent of the trouble at this time can be established.

Second operation has been done in our cases from two to four weeks after appendectomy, and is necessitated by persisting tendency toward distention, scattered tenderness, perhaps fever, and an increased percentage of polymorphonuclears. At this time in our cases there have been found multiple abscesses in mesenteric folds ranging in size from a minute spot to those containing as much as 4 ounces of thick pus. Rare cases have hidden as much as a pint behind the sigmoid, and secondary drainage is indicated here.

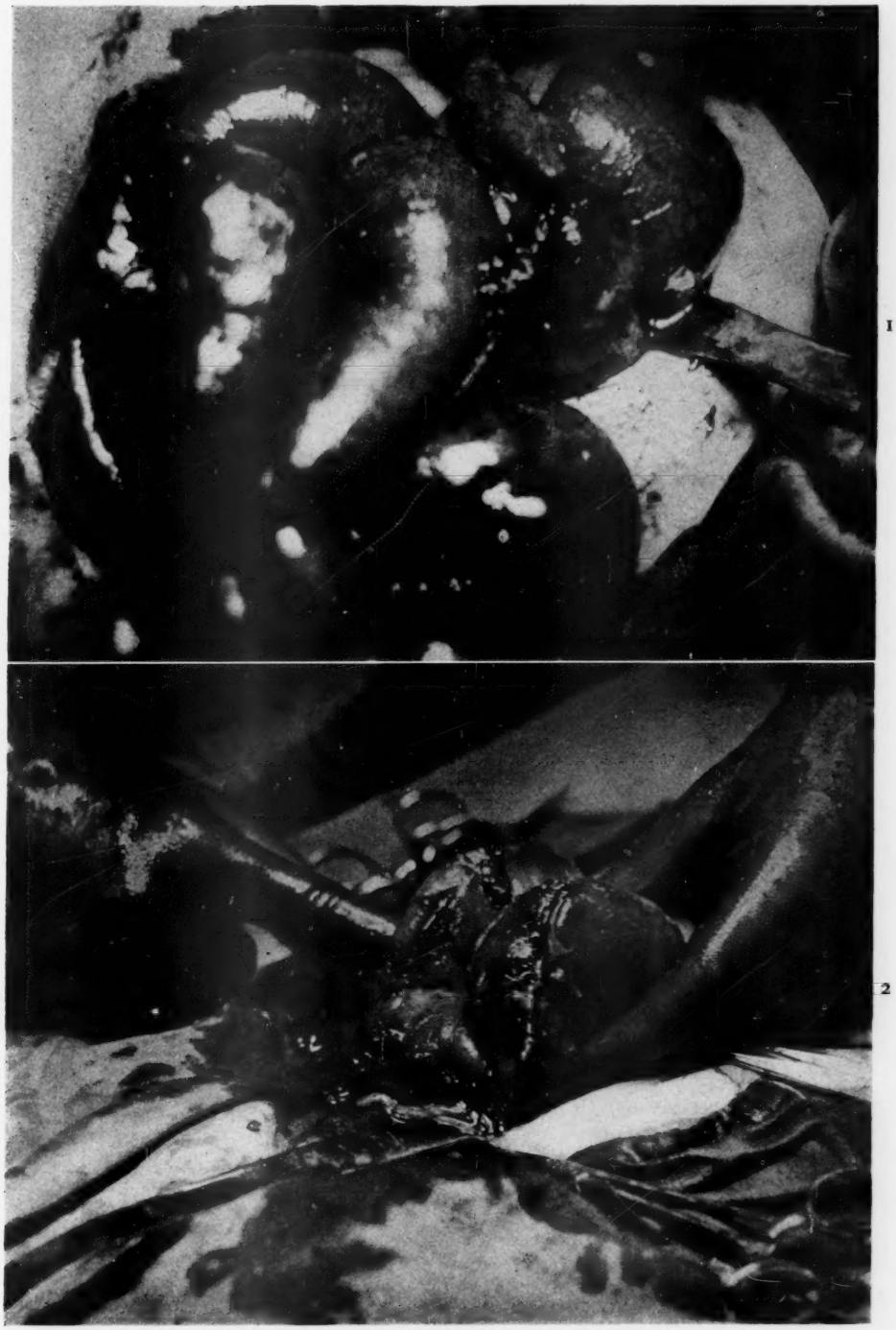

Fig. 1. Appearance of distended loops of ileum, noticeably congested on opening of abdomen. Gaseous distention after twenty-nine days of pituitrin.

Fig. 2. One region of intestine densely adherent to floor of pelvis. Denuded peritoneum, plastic lymph, constricted bowel, marked local inflammation. In the mesenteric fold lay an ounce of thick pus, other areas containing other abscess areas up to size of a baseball.

3

4

Fig. 3. Illustrating the adherence of a loop to the root of the mesentery with consequent increasing constriction and obstruction. Gas has rapidly filled the more collapsed bowel as partial liberation has occurred in presenting the region to the camera. It is this adherence to the root of the mesentery, illustrated here, which must be prevented from recurring if the patient is to remain well.

Fig. 4. After complete release the length of the mesentery permits the suturing of the intestine to be done extra-abdominally. The lines of suture in making the mesenteric approximation of plication are marked out by the Allis clamps.

5

6

Fig. 5. A single loop of plication completed, covering a mesenteric abscess and rough area of intestinal peritoneum.

Fig. 6. Five adjacent and continuous loops of plication with one wing anastomosis because of an annular constriction. Here is shown a most severe degree of destruction of peritoneum of all surfaces of the bowel. No manner of plication will cover all surfaces. Adhesion to the root of the mesentery of some loop of intestine as shown in Figure 3 is prevented by plication, and obstruction will not appear later. Omentum if present will substitute for the missing external surface of the peritoneum of the intestine, preventing fixation to the abdominal wall. If not present, as in Figure 10, the fixation to the lower parietal peritoneum of such denuded external surface of the intestine produces no degree of obstruction or symptoms referable to intestinal function, if plication has been complete, surprising though it may seem. The patient here shown has made a completely satisfactory recovery without drainage or infection, and remained free of symptoms and has returned to his gainful occupation.

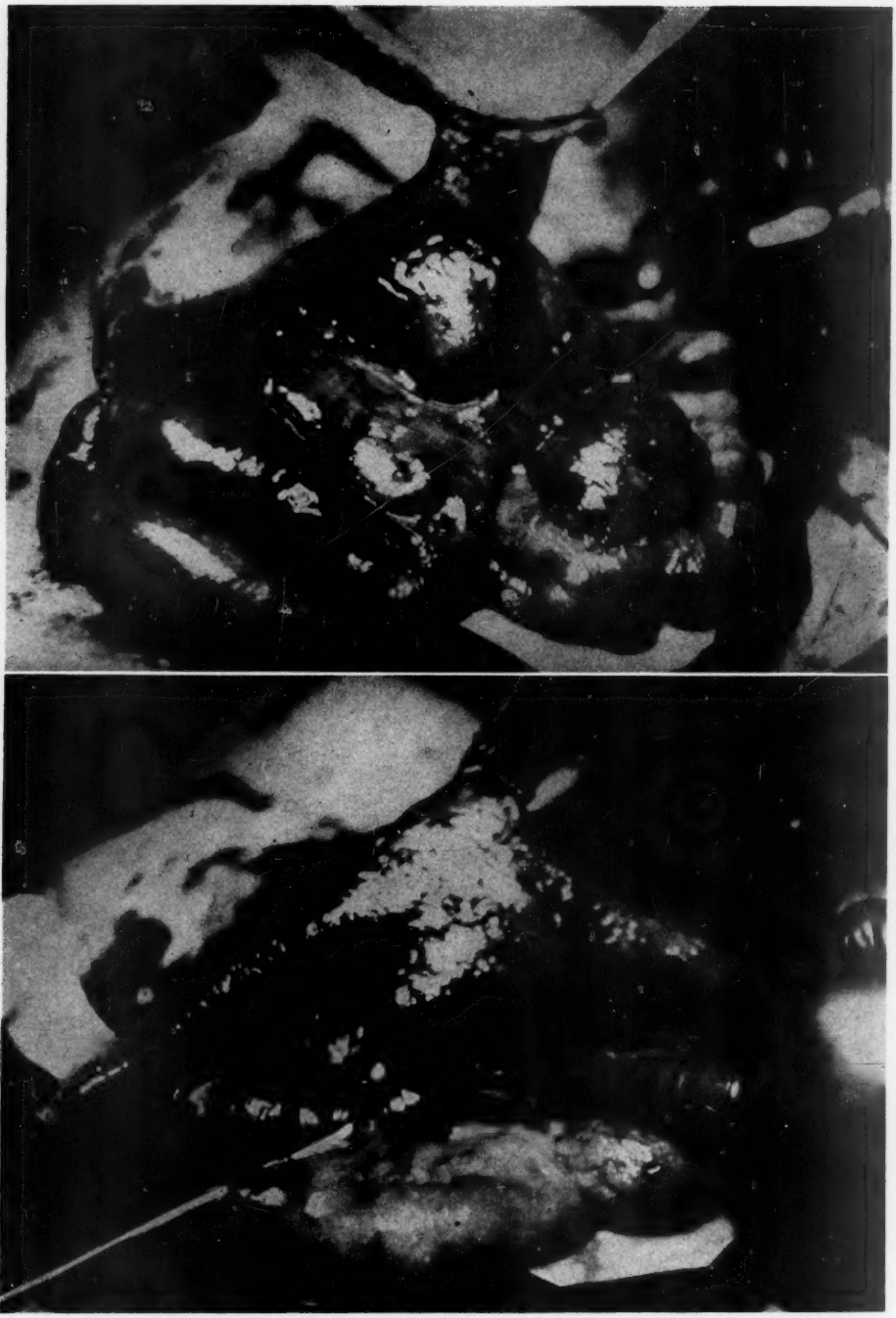

FIG. 7. A case of long standing partial obstruction following resection of an area of small bowel and resulting intestinal fistula. Report on exact nature of first operation not received. Skin at fistula opening excised and held by clamps. Dissection of loops has been completed. Note plications of bowel existing as result of peritonitis. Usable loops of this existing condition not disturbed.

FIG. 8. Same case. Fistula comes from end of proximal end involved in lateral anastomosis. Mesentery had not united at site of anastomosis, leaving a large opening through which a loop of intestine had entered and stuck fast, with developing annular constriction.

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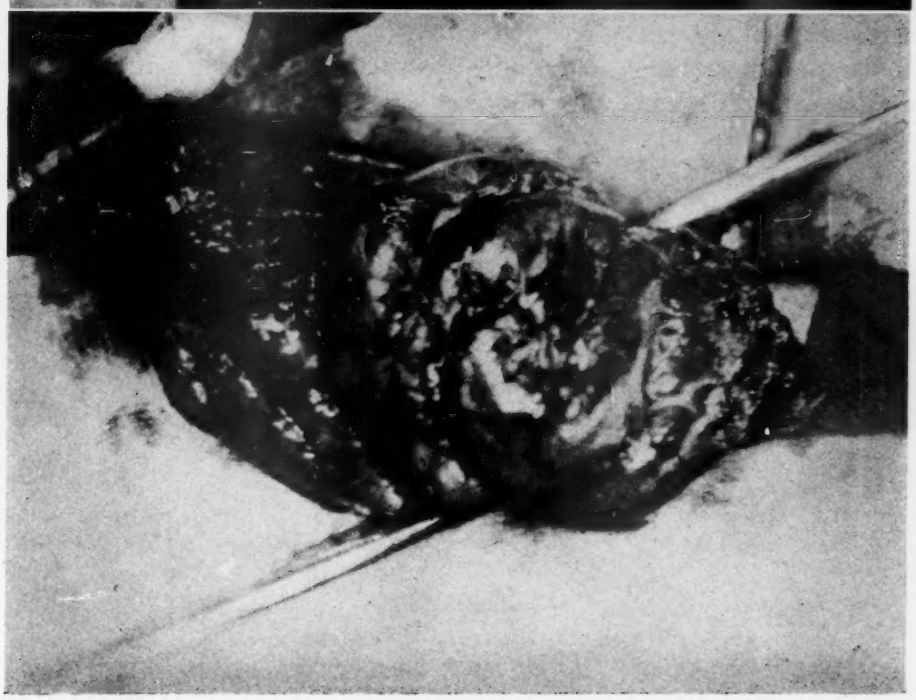

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Fig. 9. Completion of operation. Fistula has been inverted and is denoted by instrument in upper left corner of photograph. Favorable plications not disturbed but continued with other large loops plicated in such manner that opening in mesentery is covered and subsequent herniation and fixation eliminated.

Fig. 10. A print made from a natural color slide of one of the cases plicated at previous operation from the cecum to the duodenum without interruption. Photographed one year from date of plication at hysterectomy for fibroid. Diet during year has been unrestricted, and weight gain has been 60 pounds, bringing patient up to normal proportions and normal physical activity. This condition of the intestine was not disturbed, and convalescence from hysterectomy was uneventful. There is today, more than a year from the date of the hysterectomy, no abdominal complaint or inability to handle foods.

Complete liberation of all zones of adhesion, evacuation of abscesses, washing off the visceral peritoneum with an antiseptic of the non-corrosive type, plication as is indicated by the condition of the dissected bowel with wing anastomoses around points of annular constriction, through a midline incision, usually without leaving a drain: these constitute the measures taken during this second operation.

In the last ten cases of ruptured appendix complicated with widespread lower abdominal peritonitis, and coming to second operation, eight have survived and have shown no postoperative disability in function or symptom referable to the intestinal tract. Note should be made that not all cases come to second operation since some die forthright and some recover without need of second operation. Some of these latter come in years later with obstruction from a band over the ileum.

We are concerned here solely with those in whom distention persists, in whom partial obstruction remains partial only because of early and continuous activated peristalsis, and in whom mesenteric abscess is expected.

The photographs cannot show the extent of denudation of peritoneum at areas of intestinal constriction, or the mesenteric abscesses, because these are uncovered only by the dissection of the adherent bowel. Color slides showing exudates and finer differentiation of tissues serve much better. However, the chronic distention of the intestine and enough other matter do indicate to the eye the true state of the pathologic process met on opening the abdomen in these cases. The patients used in illustration are well and we feel that they could not be expected to live under any other plan of campaign.

SUMMARY

1. A serious complication of peritonitis from ruptured appendix has been described, photographed, and adequately treated through extension of the use of plication as previously described.

2. Other use of plication has been demonstrated.

3. The value of plication in eliminating certain mortality and morbidity has been shown.

4. The end result of the most extensive plication has been illustrated and described.

I wish to thank V. S. Noble for the preparation of the photographs.

CASE OF ENCHONDROMA OF PHALANX SIMULATING GIANT CELL SARCOMA

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SOLITARY cartilaginous tumors, enchondroma and ecchondroma, occur rarely in the phalanges, metacarpal and metatarsal bones. When they do occur they are of considerable clinical importance.

Chondroma is a benign tumor which may arise from cartilage anywhere in the body. Cartilage is embryonal transitory tissue and occasionally undergoes sarcomatous metaplasia. These tumors may be solitary or may arise from multicentric foci. They not infrequently grow from epiphyseal cartilage.

A chondroma when growing outwardly upon the surface of bone is known as ecchondroma; when the tumor grows into the substance of bone it is designated as enchondroma. It may thus cause expansion of the shaft and when combined with cystic degeneration may clinically and roentgenologically resemble giant cell sarcoma (Boyd[1]).

Frankenthal[2] published two cases of enchondroma of the phalanx which were cured by curettement without recurrence. A unique case of chondromatosis of a metacarpophalangeal joint was reported by Linden.[3]

Meyerding[4] of the Mayo Clinic, in 1920, reported eighteen cases of chondromata. They occurred in various sites: nine in the bones of the hand, two in the metatarsal bones, one in the sternum, one in the scapula, one in the lesser trochanter of the femur and three in the knee. The youngest patient was 3 years old, the oldest 53 years. Most of the cases were treated with local currettement; in several cases recurrence was noted, but none became malignant.

Raisch[5] reported a case of a man 56 years old who had a tumor of the proximal phalanx of the right thumb for many years, and suddenly developed metastases in the right radius and soft tissues of the forearm. After resection and eventual amputation of the arm the tumors were found to be chondrosarcoma. Obviously the tumor of the phalanx existed as a benign chondroma for many years before it became malignant and metastasized.

Allende[6] reported a case of chondromata of a metacarpal bone and several phalanges of the left hand of a child of 14 years. It was after several years that the tumor suddenly became malignant, ulcerated and metastasized to the lungs.

CASE REPORT

C. G., female, 70 years of age, complained of pain and progressive enlargement of the proximal phalanx of the fourth finger of the left hand. In 1926, she had accidentally slammed a door upon the left hand. The finger became progressively larger and painful. In 1933, she had received a series of deep Roentgen ray treatments at a local cancer hospital, where the lesion was diagnosed as giant cell sarcoma. She had received this form of therapy at irregular intervals; during June and July, 1936 she sustained in the course of these treatments a severe Roentgen ray burn of the finger which was followed by persistent severe pain.

Upon examination, the proximal phalanx of the fourth finger of the left hand was found to be enlarged to about three times the size of the corresponding finger of the other hand. It was firm, irregular, fusiform in shape and contained a bony tumor which clinically looked like a malignant neoplasm. The finger could not be flexed at the proximal or middle joints. The skin showed a recent diffuse burn on the anterior and posterior aspects of the finger and the margins of the adjacent fingers. No enlarged lymph nodes were present in the antecubital, epitroclear or axillary regions. The pain could not be relieved by narcotics. Roentgen exami-

FIG. 1.

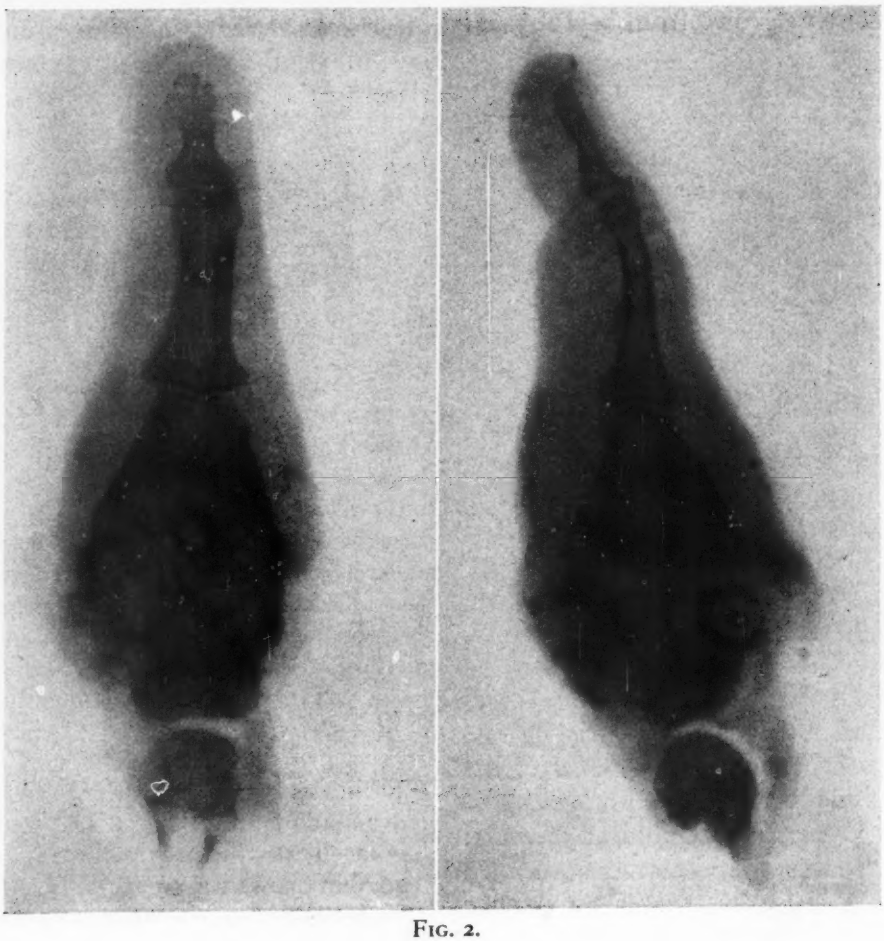

FIG. 2.

nation was not considered advisable in the presence of the burn. (Fig. 1.)

On August 10, 1936, I amputated the fourth finger of the left hand through a racket incision. The patient was permitted to go home two days after operation. The sutures were removed after seven days, but it was four weeks before the incision was completely healed. This I believe was due to a lack of vitality of the tissues resulting from the Roentgen therapy.

Observation of the patient for two years subsequently does not reveal any metastases.

Roentgen examination of the finger was made after amputation by Dr. H. B. Phillips. He reported the presence of a cystic bone tumor involving the entire shaft and proximal end of the proximal phalanx. There was fusiform dilatation of the phalanx and considerable subperiosteal proliferation. The cortex of the bone appeared to be perforated on the flexor aspect. The lesion resembled that of a thoroughly irradiated giant cell sarcoma. (Fig. 2.)

Pathologic examination of the amputated finger was made by Dr. Julius Pincus who reported that the entire mass measured 10 cm. in length and 3.5 cm. at the widest diameter. The skin showed brownish discoloration from the tip of the finger to its base. There was a fusiform tumor, apparently well encapsulated, involving the entire phalanx. On cross section, the tumor was soft, cystic and filled with gelatinous material.

Microscopic examination of the bone tumor showed a cartilaginous structure growing inwardly to the medulla of the bone. The bony tissue was necrotic in places and also showed myxomatous degeneration. Newly formed young fiber bone had replaced the normal marrow tissue. No malignant change was noted. (Fig. 3.)

Fig. 3.

The diagnosis was enchondroma of the phalanx.

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LOW BACK PAIN AND SCIATICA SECONDARY TO A STRAIN IN A PRESPONDYLOLISTHESIS OF THE FOURTH AND FIFTH LUMBAR VERTEBRAE

REPORT OF A CASE

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THIS report of a single case is made not because the occurrence is rare or its symptomatology unusual, but to center attention on a lesion the pathology of which is not generally appreciated, and to emphasize the potential disabling effects of a trauma on the soft tissues in a prespondylolisthetic area.

Definitions. It is important at the outset that two terms shall be defined so that we may understand the significance of each of them.

Sciatica. This term implies the presence of pain along the course or in the distribution of the sciatic nerve. There may be an accompanying variable atrophy of the thigh and a diminished or absent ankle reflex. There are no sensory, motor or trophic changes such as are found in a sciatic neuritis. Sciatica, for the present a term of convenience, is the name of a symptom and not of a disease.

Prespondylolisthesis. This term, first used by Dr. Armitage Whitman, has been employed by the present author and others to describe the existence of a congenital laminar defect in one of the lower lumbar vertebrae, it being assumed that the existence of a defect in the posterior arch of one of the lumbar vertebrae predisposes this vertebra to an actual future displacement of its body, or spondylolisthesis. Such an occurrence has actually been described, justifying the use of the term. In November, 1937, at a joint meeting of the New York Academy of Medicine and the Philadelphia Orthopedic Club, Dr. Ferguson of the New York Orthopedic Dispensary and Hospital reported an instance in which a prespondylolisthesis became a spondylolisthesis. He described the case of a girl of 15 years who, at the present time, has a spondylolisthesis, while three years ago, as the roentgenograms definitely show, she had only a laminar defect without vertebral displacement, that is, a prespondylolisthesis. Prespondylolisthesis implies the existence of a bony defect in the posterior arch of the vertebra resulting from lack of fusion of the lamina and pedicle.

When one sprains an interphalangeal joint of a finger it is natural to find pain radiating to the very tip of the finger and also up towards the hand, by reason of pressure on and irritation of the digital nerves. Similarly in other joints a soft tissue lesion, such as a sprain of the external lateral ligament of the ankle or of the medial ligament of the knee, results in pain not only locally but also in structures some distance away from the primary lesion. In exactly the same way an injury to the soft tissues in the lower lumbar area, particularly in the region of the vertebrae, may irritate the fibers entering into the formation of the sciatic nerve and cause sciatic pain in the thigh, leg or foot. The laminar defect in a prespondylolisthesis of the fourth or fifth lumbar vertebra is close enough to the sciatic nerve so that when the connective tissue which bridges the bony hiatus is subjected to an injury the resultant hemorrhage and edema may extend to and irritate the sciatic nerve.

In the case herein reported the neural arches of the fourth and fifth lumbar vertebrae were weakened by the existence

of a laminar defect in each of them. The sudden, violent muscular effort, which under normal conditions, that is, in an individual with bony neural arches intact, might not have caused any damage, resulted in this patient in a strain of the connective tissues uniting the segments of the neural arch. The pathology of a strain involving not only the laminar bridge of connective tissue but also the nearby soft tissues, consisting of a tear of tissue, hemorrhage and edema, resulted in local pain, or backache, and sciatic pain, or sciatica.

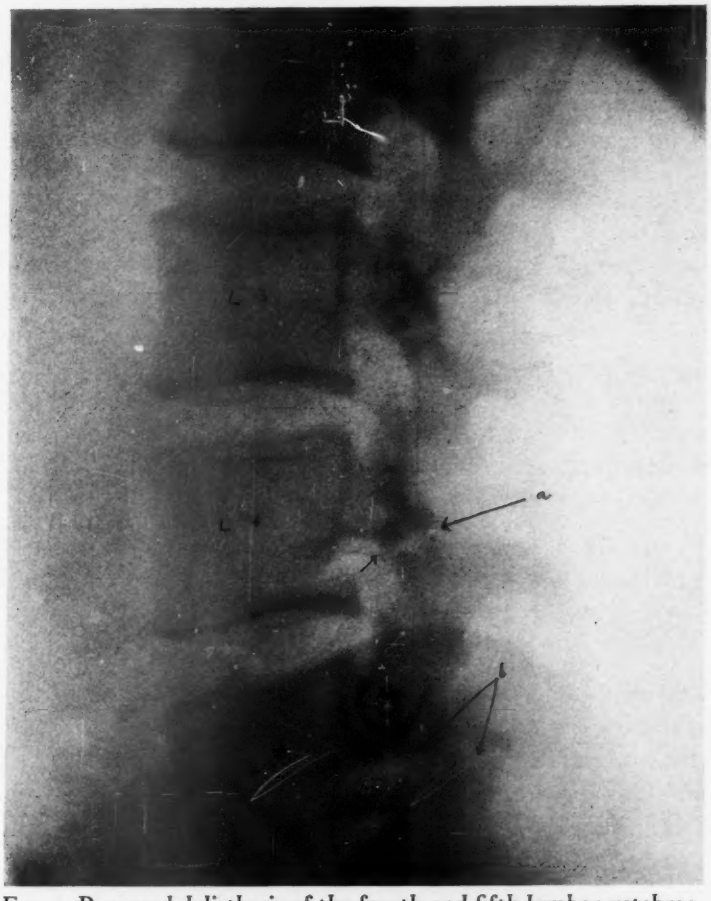

Fig. 1. Prespondylolisthesis of the fourth and fifth lumbar vetebrae. *a* and *b*, osseous laminar defects.

CASE REPORT

A male, 38 years old, a professional dancer, was referred on January 5, 1938 with a chief complaint of pain in the lower part of the back and along both sciatic nerves, aggravated by exercise and relieved by rest. On a number of occasions during the previous few years, after strenuous dancing, he had had fleeting pains in his lower back. On August 15, 1937 he was engaged in a dancing act in which at one moment he was set with his trunk erect, his lower limbs flexed at the hips and knees, and his arms outstretched, ready to catch on his shoulders two dancing partners, who were to jump down from a slight height. There was a slip-up in the timing and his partners did not jump as they were supposed to. The patient, in a quandary about the situation, arose very suddenly and violently, and as he did so he felt a sharp pain in his lower back. The pain has persisted and has disabled him.

Examination revealed that the antero-posterior motion of his spine was markedly restricted. Forced motion of the spine caused pain in the lower lumbar area and along both sciatic nerves. Straight leg raising on either side was limited and caused low back pain. There was tenderness to pressure over the

lower lumbar vertebrae. The sensory and motor functions and the reflexes were normal. The lateral roentgenogram of the vertebrae showed a laminar defect in the fourth and fifth lumbar segments. (Fig. 1.)

The clinical and *x*-ray findings led to a diagnosis of a strain of the lower back, weakened by the previous existence of a prespondylolisthesis. The patient was provided with a low back support and was given physiotherapy. He continued at his work of dancing, but omitted the act requiring unusual strain of his back. Within a month he was greatly relieved and discontinued treatment.

CONCLUSION

In this case we have an instance of a congenital osseous defect in the laminae of the lower lumbar vertebrae which established a locus minoris resistentiae. A violent muscular effort strained, that is stretched or tore, the connective tissue bridging the laminar defects, giving rise to backache and bilateral sciatica. Conservative treatment has so far relieved the symptoms in this patient. However, since he has had several attacks of backache, it may be assumed that sooner or later it will become necessary to perform a spine fusion operation to unite the laminae of the third, fourth, and fifth lumbar segments and the first sacral segment and thereby eradicate the weakness resulting from the congenital defect in the posterior arches of the fourth and fifth lumbar vertebrae.

VERY often, pain seems to depend on some excess in respect of quality or duration over the normal action of vaso-constriction or vaso-dilation. It may be brought about, or suppressed, by some abrupt vaso-motor change, whether spontaneous or otherwise.
From—"The Surgery of Pain" by René Leriche (Williams & Wilkins).

SACRO-INGUINAL SINUS

REPORT OF A CASE

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THE following case is noteworthy because of the difficulties which developed after an apparently trivial injury. The incidence of such conditions is believed to be extremely rare and the surgical management a complex problem. The case is one of sacro-inguinal sinus complicated by a simple vertical fracture through the tip of the sacrum and coccyx.

CASE REPORT

A white male, aged 21, a coal miner, was seen following a motorcycle accident in which the handlebar cut his upper right thigh. He complained of severe pain in the lower back and right groin. Examination revealed a deep laceration, undercutting in type, just below and parallel to Poupart's ligament, exposing the femoral vessels. Emergency therapy included débridement and closure with silkworm sutures.

On the day following injury the patient seemed in good general condition. He complained of moderate pain in the right groin, and also of coccygeal pain at times quite severe.

He stated that he had always been in good general health, having had no previous injuries and no operations. He was not alcoholic. There was no history of any familial disease. The temperature was 99, pulse 92, and repiration 18. The patient weighed 165 lb. The blood pressure was 118/78. Other physical findings were normal except for recent injuries. There was pain and tenderness over the coccyx and lower sacral region, but no swelling. There was pain and tenderness over the right groin with moderate swelling. The red cell count was 4,800,000, white cells 8,900, with 76 per cent, polymorphonuclears, 20 per cent lymphocytes, and 4 per cent mononuclears. The urine revealed no pathologic findings.

An *x*-ray of the sacrococcygeal region revealed a vertical fracture in the midline through the lower sacrum and the coccyx. Position of the fragments was good.

A few days following admission the patient became quite toxic and delirious, with a temperature of 103. Examination of the wound in the right groin revealed increased swelling and sloughing of some of the sutures. The sutures were removed with subsequent gradual improvement of the patient. The wound took on a healthier appearance and began to granulate. Pain in the coccygeal region persisted. Coccygectomy was deemed inadvisable in the presence of infection. Bed rest was the only consideration to the fracture. After several weeks the wound had closed with the exception of a small sinus at the lower angle. This persisted.

Six weeks following injury the patient developed a chill, a rise in temperature, associated with pain in the right lower abdomen. There appeared swelling, tenderness, and fluctuation in the right grain just superior to Poupart's ligament. It was decided to explore this region under anesthesia. Incision and drainage disclosed a profuse discharge of necrotic and purulent material. This resulted in gradual improvement. However, drainage persisted for eight weeks. At the end of that time the wound healed by second intention.

In spite of persistent care the original wound failed to close completely. It was presumed that drainage was inadequate as the patient remained slightly septic, the temperature ranging from normal to 99.3 daily. It was decided to open the primary wound and explore it for pockets. A sinus was found leading into the pelvis, extending beneath Poupart's ligament and over the bladder, rather tortuously. A uterine sound was inserted into the sinus which apparently led to the sacrum. The walls of the tract were curetted and a No. 20 catheter left in situ. The evening following operation was a very stormy one for the patient. He became quite delirious and his temperature

rose to 105. His coccygeal pain was aggravated by our procedure. With general care in a few days there was a decided improvement. The young man, however, had lost 40 pounds in weight since his injury.

Drainage from the wound was very profuse for the first week following the insertion of the catheter. Gradually the discharge diminished and the patient's temperature remained normal. After a month he was discharged to the out-patient department and the wound was irrigated daily with Dakin's solution. This resulted in a very marked general improvement but the sinus persisted.

An *x*-ray of the tract was taken following injection of bismuth in vaseline. This revealed a tortuous sinus passing from the right groin over the bladder and thence to the mid-anterior surface of the sacrum. The report added that there was a suggestion of bone necrosis in the region of the lower sacrum.

The patient improved as long as the catheter remained in situ. Any attempt to promote healing by withdrawal of it failed. Pain in the lower back persisted. He was advised to submit to an operation for excision of the coccyx. It was thought that bone necrosis might be responsible for infection of the tract.

On October 1, 1935, the entire coccyx and lower portion of the sacrum were excised. They revealed gross evidence of necrosis. The base of the sinus was not explored due to danger of injuring the soft structures. The wound was closed leaving one rubber tube drain in place. Convalescence was uneventful. Coccygodynia disappeared. The patient was discharged from the hospital October 21, 1935 and two weeks later the incision had healed. Drainage from the right groin continued but seemed less profuse. It was irrigated twice weekly with 5 per cent mercurochrome.

In January, 1936, the catheter was gradually withdrawn and irrigations performed once a week. This resulted in improvement. After a few more weeks the catheter was removed and re-inserted periodically for irrigation. Complete closure of the sinus resulted on February 14, 1936. The patient's temperature remained normal, the white blood count was 7,900. He had no complaints except for numbness in the left leg. This was attributed to scar formation in the region of the left iliac vein where there was apparently a mass palpable.

The patient was seen six months following discharge and was in excellent physical condition.

SUMMARY

A case of sacro-inguinal sinus, complicated by fracture of the lower sacrum and coccyx, is presented. Osteomyelitis of the sacrum and coccyx either caused the sinus or prevented its healing. Infection cleared up following removal of the involved bone at the base of the tract. After many months of treatment and observation the patient made a satisfactory recovery with no sequelae.

ASPIRATION OF BLUE DOME CYST*

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CASE REPORT

AN unmarried nurse of 42, first seen July 6, 1934, had had pulmonary tuberculosis fifteen years before, with apparently satisfactory arrest after three months bed rest at home. Her menses had been regular every twenty-six days, with no pain, the flow lasting from two to four days. She complained of migraine headaches, and there had been slight serous discharge from the nipples a few days before each period for several years.

Her present complaint was a lump in the left breast which had developed suddenly four days before. There had been no previous discomfort, no previous trouble with the breast, and no swelling during the menses.

There was a firm irregular dense mass ¾ inch in diameter at the outer tail of the left breast, 2½ inches from the nipple. It lay superficially underneath the skin, moved easily, and was not attached to the skin, but was somewhat attached to the breast tissue about it.

A radial incision was made in the outer portion of the left breast, widely excising the tumor mass (July 9, 1934). The cut surface showed a typical blue dome cyst. Two or three cysts were entered, discharging thin fluid.

Microscopic examination showed numerous small cysts, apparently well encapsulated, scattered through an indurated mass of breast tissue. The microscopic diagnosis was chronic cystic mastitis.

The patient was well until January, 1935. Then she noted another cyst in the right breast. This was aspirated one week after onset, and 10 c.c. of amber colored fluid was obtained. The breast tissue was thereafter normal in texture.

Six months later, and one year after the original operation on the left breast, the patient noticed an indurated mass in the left breast below the previous upper outer quadrant scar. This was excised under local anesthesia in the office (July 11, 1935). Microscopic examination showed chronic cystic mastitis.

She was again well for a few months. Then (October, 1935) she noticed a small swelling in the outer quadrant of the right breast where aspiration was done one year before. A small firm thickening was noted at this site. This was watched for six months, and as the mass seemed to grow a little larger and felt cystic at one spot, it was excised (April 15, 1936). A large irregular mass was removed including all of the upper outer quadrant of the right breast tissue. The mass was cystic. One blue dome cyst was punctured, evacuating clear fluid. The microscopic diagnosis was chronic cystic mastitis.

Trouble recurred in the left breast two months later (June, 1936), when a cyst came up suddenly in the mid-portion of the left breast, toward the center from the previous scar, and apparently entirely distinct from the old involved area which had been excised. On July 25, 1936 it was aspirated and 20 c.c. of thick glairy greyish opaque material was removed.

There has been no reaccumulation and the patient has been well since. When last seen (February 1, 1938) menses were still regular, with moderate flow for four days and no pain.

The right breast was smooth, soft, and supple, but there was a heavy scar in the outer upper quadrant. The left breast showed a soft broad scar in the upper outer quadrant and some induration between the scar and the nipple, though this seemed less than before. The upper midportion, where the cyst was aspirated, was soft and smooth.

SUMMARY

The history of a patient in her early forties is recorded. She had had no previous breast abnormality except slight serous discharge before menses in earlier years which had subsided. A blue dome cyst suddenly appeared in the left breast and local excision was done in 1934. A second local excision of an adjoining portion of the left breast was done one year

* Read before the American Society for the Study of Neoplastic Diseases, Washington, D. C., September 10, 1937.

later (1935). Another cyst was aspirated in 1936. Two years later she was well. In the right breast, a cyst was aspirated in January, 1935.

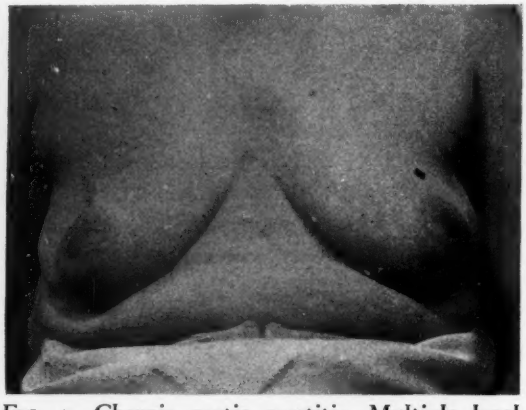

FIG. 1. Chronic cystic mastitis. Multiple local excisions and aspirations. Two local excisions in lateral portion of left breast. Aspiration of another cyst at black mark in mid-portion of left breast. Well two years. Aspiration of another cyst in right breast. Local excision later because of persistent induration.

Induration persisted in the outer upper quadrant of the right breast. In January, 1936 excision of a wide area in upper outer quadrant was done. The patient has remained well since.

DISCUSSION

Frank S. Mathews, in a paper read before the New York Surgical Society in 1935, reported that he had aspirated fifty cysts of the breast in twenty years, and added that: "There seems a very strong prejudice on the part of surgeons against aspirating cysts. One is usually told that it is dangerous teaching. None of the surgeons with whom I have discussed the subject admit that they ever resort to aspiration. No paper which I have seen which considers the subject of treatment mentions aspiration of cysts, even to condemn it."

Breast cysts constituted 8 per cent of 664 breast cases reviewed by Adair. They appear usually in the late thirties or early forties, and tend to become smaller as the mammary tissue atrophies after the menopause. They may appear with one period and completely disappear before the next menstrual phase. A relationship between cysts of the ovary and breast has often been noted.

If the contents are bloody, all authorities agree that operation should be done, since the danger of cancer is real—48 per cent in Adair's series.

If there is muddy colored fluid, it is not always cured by aspiration, and infected straw-colored fluid always refills.

If, however, the contents are clear straw-colored or opalescent, it is a perfectly benign condition with no danger of associated malignancy. Adair cured 85 per cent by simple aspiration. Others have concurred in this opinion or reported series of cases followed up and no future malignancy observed (Mathews, Pickhart, Klingenstein, Bull, Abbe, Cheadle and Cutler) so that aspiration of a simple cyst containing amber or opalescent fluid is quite safe and rational.

The breast tissue should be flat and no induration should be left after aspiration. If the cyst refills promptly, it is best to resort to surgery (Mathews).

CONCLUSION

A case of chronic cystic mastitis is reported. Multiple local excisions were done; also cysts in each breast were aspirated. Indications for aspiration are discussed.

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SARCOMA OF THE VULVA*

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THE high mortality and the certain fatal outcome represented by a vulvar sarcoma is well known. The case here described is unusual in that the patient is alive and well four years after the tumor was removed. The absence of metastasis over this long period as well as the rarity of this malignancy warrant the presentation of facts which follow:

S. K., an obese, 45 year old Russian born housewife, was admitted to the gynecologic ward, January 2, 1934. She had had five normal pregnancies. Menses were always normal before the onset of the menopause one year prior to admission. For sixteen years the patient had observed the slow growth of a nodule in the left labium, until it reached the size of a large grapefruit. There had been periods of two to five years during which no enlargement occurred; in the intervals, however, the size increased and the mass became inflamed and ulcerated. Recently she had experienced difficulty in walking because of the tumor. There were no other complaints or symptoms.

Examination. A firm, nodular, grapefruit-sized mass was found broadly attached to the left vulva. (Fig. 1.) The clitoris at the upper margin of attachment was concealed behind the mass. The flattened left labial fold surmounted the anteromedial surface. The overlying skin was tense, movable, and ulcerated on the inner aspect. The inguinal glands were not enlarged. The general physical findings were normal. Wassermann and Kahn tests were negative. Blood pressure was 128/78, hemoglobin 84 per cent, sedimentation rate seventy minutes. A diagnosis of fibrolipoma was made.

Operation and Findings. Under gas, oxygen and ether anesthesia a longitudinal incision through the skin was made 2 inches lateral to the labial edge. The tumor was removed by both blunt and sharp dissection. Its fossa completely covered the descending ramus of the pubis, reaching the vaginal wall medially. The tumor and its capsule were removed completely after several large vessels were ligated, and the skin was then closed. (Operation was done by Dr. U. J. Salmon.)

Pathologic Report. The specimen was described as grapefruit-sized (10 × 8 cm.), moderately edematous, soft and pliable, and gray-white in color. The capsule was thick and injected and contained several areas of hemorrhage. Large gaping blood vessels were noted.

When sectioned, the cut surface appeared glossy, edematous and white. It was smooth throughout except for several small loculi and a discrete, round yellow area, containing tiny, coalescent, irregular elevations, punctate in character.

Microscopic sections were reported by Dr. Paul Klemperer as polymorphous cell scarcoma of the vulva.

Postoperatively, *x*-ray radiation, totalling 1200 R units was given directly over the left vulva. It is now four years since operation and no complaints referable to the original condition have been reported by the patient. The chest, pelvic bones and lower spine, recently *x*-rayed, revealed no metastasis.

DISCUSSION

The literature contains about 100 reports of cases of malignancies of this category. The mortality is very high.

Fraenkel[10] states that the incidence of 0.01 per cent, inclusive of melanosarcoma. E. Kehrer, in the Veit-Stoeckel Handbuch,[13] collected from the literature up to 1929 seventy-seven vulvar sarcomata, excluding melanosarcoma. In 62 per cent they arose from the labium majus, in 11.4 per cent from the labia minora. Sarcomata have also been found in the round ligament,[19] in fibromata,[15,16] in Bartholin glands,[2,12] and in vulvar elephantiasis.[5] Taussig[31] believes that many are derived from the fibrofatty substance of the vulva rather than the fibrous element alone.

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Histologically, the type described are spindle,[11] round,[32,33] giant,[29] and polymorphous cell.[19] Myxosarcoma,[23,31] fibro,[4] lipofibro,[14,30] and lymphosarcoma,[31] are reported. Endothelial,[6] perithelial,[25,26,3] and angiomatous varieties are mentioned.

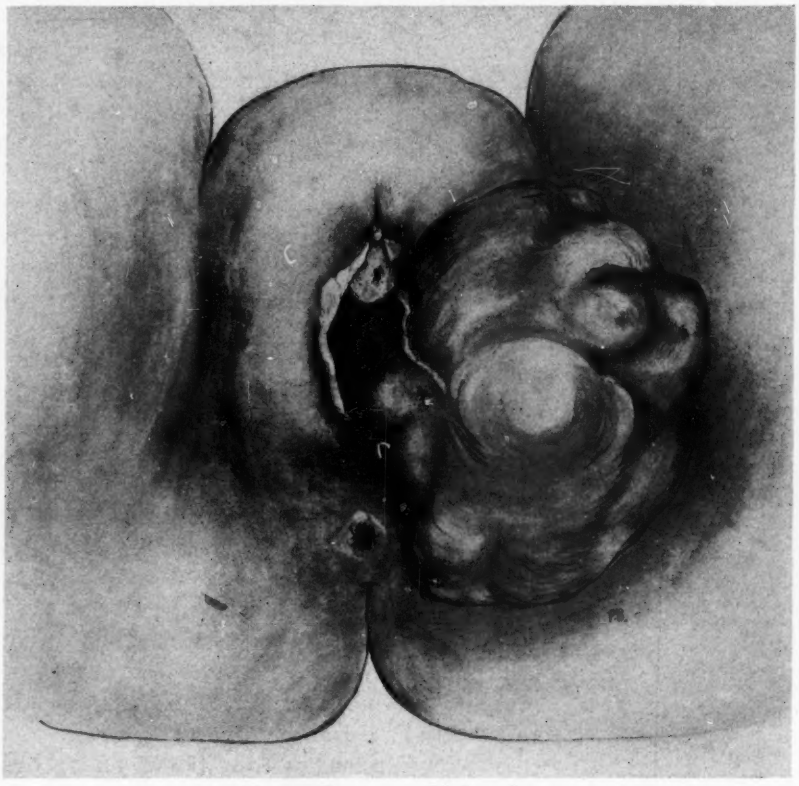

Fig. 1. Sarcoma of left vulva.

Blair Bell,[1] in twenty-one cases, found the myxosarcoma most common. In a group of twenty-six collected cases, R. T. Frank[8] states there were ten myxosarcomata, four fibro-, six spindle-, three polymorphous, and one each of peri, endothelial, and angiosarcoma.

Taussig[31] feels that many of the round cell sarcomata would now be called lymphosarcomata, in view of the recent changes in the malignant tumor classification.

The age incidence is agreed to be between 30 and 50 years. The average age of incidence is 40 years. However, H. S. Morgan[20] reports one case in a child of sixteen years.

R. T. Frank[8] states that these tumors resemble fibromyomata until ulceration and infiltration takes place. They begin as small pedunculated or sessile growth, and may spread locally in the early stages. They differ from carcinoma and melanosarcoma in that the lymphatic vessels are rarely involved until very late.

Local metastases are found both early and late. Nebesky,[21] found extension in four cases of urethral sarcoma, secondarily to the vulva, vagina and inguinal glands. B. P. Watson's case,[31] was similar. Distant metastases are the rule, however, especially after operation and also late in the disease.

Maas and Olshausen[15] have reported a case with five year freedom from recurrence and Rhomberg[24] an even longer period.

The prognosis is always grave, since the disease is usually fatal because of metastases to vital organs. As regards recurrence after excision, the prognosis is also bad. In five instances, E. Kehrer[13] reported that gestation exercised no influence upon the growth of this tumor.

Diagnosis is rarely made clinically. The microscopic picture is always necessary and final.

Treatment. Early excision offers the only hope of cure. Recurrent local lesions should be repeatedly excised. The value of radium and *x*-ray seems quite questionable. Surgical procedures employed are usually simple and not attended by serious sequelae.

SUMMARY

1. Sarcoma of the vulva is a rare disease: about 100 cases are reported in the entire literature.

2. The mortality is exceedingly high.

3. A brief résumé of the characteristics of this malignancy is given.

4. The case presented is unusual in that four years after operation, there are (1) no complaints referable to the original tumor; (2) *x*-rays reveal no metastasis, (3) there are no nodes palpable externally. The patient is clinically cured.

5. A survey of the limited literature and a brief discussion of the clinical course of the disease is also given.

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SO-CALLED "LIVER DEATH" SYNDROME FOLLOWING THORACOSTOMY

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IT was in 1924 that Charles Gordon Heyd[8] first announced the syndrome which has since been termed "liver death." As Sutton[14] describes it, "the so-called high temperature, liver death syndrome is a clinical entity characterized by rapid progressive development of high fever, fall in blood pressure, circulatory collapse, coma and death, with temperature rising as high as 109°F. within thirty-six to forty-eight hours after operation."

So-called "liver deaths" with few reported exceptions have occurred after surgery on the biliary tract. Although it is only thirteen years since the syndrome of "liver death" was first recognized as a clinical entity, there have accumulated in the literature more than 100 cases of this kind. A search of the literature does not reveal a single case of high temperature death following thoracic surgery.

The only demonstrable pathology in "liver deaths," as determined at postmortem examination, is passive congestion, softening and diffuse disorganization of the liver cords with widespread focal necrosis of the liver. Experimental work done on dogs by Sutton[14] showed that similar clinical causes and living changes were produced in six of fourteen dogs by the ligation of the hepatic arteries. In eight dogs which did not die, adequate collateral circulation to all lobes of the liver was found and there was no hepatic necrosis. Crile[5] believes that there is also interference with the heat regulating mechanism of the body. However, this has not been proved.

The following case fits the definition of "high temperature, liver death syndrome" in that thirty-one hours after operation the temperature began to rise rapidly, there was circulatory collapse, followed by coma and death occurred just thirty-five and three-quarter hours after operation.

CASE REPORT

J. B., male, aged 60 years, white, Polish, a baker by trade, contracted dry pleurisy of the lower right pleura on November 9, 1936, and was treated symptomatically. Three weeks later (December 3), he developed a right lobar pneumonia. He was treated at home and was making a normal recovery until December 15, when his temperature began to rise and he complained of pain in the right chest at the base. A diagnosis was made of delayed resolution of the pneumonia associated with an encapsulated empyema of the right pleura.

The patient was admitted to the Grace Hospital, Detroit, on December 22, 1936. *X*-rays taken on admission confirmed the diagnosis of pleural empyema and unresolved pneumonia.

On admission the chest showed some swelling of the lower right wall with obliteration of interspaces. The lungs exhibited diminished excursion on the right side and absent fremitus at the right base. Flatness on percussion was noted from the eighth right rib to the base with absent breath sounds in the same area. Above the eighth rib right posteriorly, breathing was vesicular. Bronchovesicular breathing and many crepitant râles were heard over the left lower lobe. The heart was negative except for a slight shift to the left.

Hemoglobin was 15 Gm. (90 per cent); erythrocytes numbered 4,380,000; leucocytes, 11,400, with polymorphonuclear cells 81 per cent, (filaments 56 per cent, non-filaments 25 per cent), small lymphocytes 15 per cent, monocytes 1 per cent, and metamyelocytes 3 per cent. No abnormal red blood cells were seen. Sputum showed no pneumococci present. Culture of pus from thoracentesis was positive for

pneumococci. Urinalyses on December 22 and 24 were essentially negative.

On December 24, under novocaine infiltration anesthesia, thoracostomy was done. The empyema cavity was opened and two soft rubber drains inserted. About 400 c.c. of thick pus was drained off at the time of operation.

For the next twenty-hours the patient's condition was satisfactory. The following morning, however, the patient was cyanotic and required oxygen therapy. His pulse was 128 and was weak. He was mildly delirious. He was catheterized at 1:30 P.M. and 300 c.c. of urine was obtained. This was all the urine passed in sixteen and one-half hours and the patient did not void thereafter. Coma developed about 3 P.M., and shortly thereafter pulmonary edema appeared. The patient's temperature rose rapidly. At 8 A.M. it was 102°F.; at noon 102.8°F.; at 4 P.M. it was 107; and just before death it was 108. At noon the pulse was 150 per minute. Digalen was given without effect. Thereafter, the pulse was too weak to count. The patient expired in coma at 8:45 P.M.

DISCUSSION

Heyd,[11] in his most recently published article on this subject, gives a revised classification of liver deaths, viz:

"1. Those associated with hyperpyrexia and coma—a rapidly developing lethargy, stupor and coma, death terminates the picture in from eighteen to thirty-six hours.

"2. Liver deaths in the presence of a constantly diminishing jaundice—slowly developing stupor and coma; final clinical picture is similar to 'cholemia death' from cirrhosis of the liver.

"3. Liver deaths associated with some unrelated kidney disease—anuria is a factor in the terminal picture. Forty-eight hours after operation the clinical picture is not dissimilar to shock, with cold, clammy skin; failure in water elimination and a marked rise in non-protein nitrogen."

Thus, according to Heyd's classification the case herein reported readily falls into group 1.

As has been said, most of the cases of "liver deaths" follow biliary surgery. But in 1935 Connell[4] reported five instances of high temperature deaths occurring after operations other than on the biliary tract. And in 1937 De Courcy[6] reported two cases of "liver death," one following colostomy and the other after hysterectomy for simple fibroid.

Boyce and McFetridge[1] recently reviewed a number of casually selected autopsies covering burns, intestinal obstruction and thyroid disease and were struck with the resemblance of these cases to the hyperpyrexic and hepatorenal deaths following biliary surgery.

The fact that "high temperature, liver deaths" can occur following surgery other than on the biliary tract, brings up for consideration the factor or factors responsible for this fatal syndrome.

LIVER DEATHS OF TOXIC ORIGIN

The prevailing opinion regarding the cause of "liver death" is that it is of toxic origin. Boyce and McFetridge,[2] studied thirty-four cases of this type and performed experiments on animals, which included the injection into dogs of saline and aqueous extracts made from the liver of patients who died with the typical "liver death" syndrome. As a result they came to the following conclusions:

"1. The underlying factor is some degree of hepatic damage, either preëxistent or the result of direct trauma;

"2. When the added strain of operation is superimposed on the existing hepatic disability, the damaged liver cells release into the circulation some potent, water soluble toxic substance."

If we accept this theory as a working hypothesis, is it the final explanation of the underlying factor of liver death? It is possible that another factor enters into the picture, a factor, perhaps, which exists only in vivo, not discernible at autopsy.

What caused the "liver death" in the case herein presented? As far as could be determined clinically, there being no autopsy, there was a minimum of liver damage such as might be expected following a protracted pneumonia and concomitant empyema. The operative procedure

was simple and should have lessened the toxemia. Nevertheless the patient died a typical "high temperature, liver death."

On the basis of Sutton's[17] experimental work on the ligation of the hepatic artery with the production of a typical liver death syndrome, a thrombosis or embolism of the hepatic artery could be the cause of death in this case.

However, thrombosis of the hepatic artery is so rare, there being only two authentic cases on record, that the results of this sort of accident are unknown. Embolism of the hepatic artery is also comparatively uncommon. Either thrombosis or embolism of this artery would produce approximately the same pathology as was experimentally produced by ligation, i.e., necrosis of the liver.

Thrombosis of the hepatic veins is also rare and would not be likely to produce the same effect as we observe in "liver death."

While thrombosis or embolism of the hepatic artery is a possibility, it is a rather remote likelihood.

There is another way, however, by which the hepatic circulation, theoretically at least, could be occluded, namely, through the sympathetic nervous system.

AUTONOMIC SYSTEM'S RÔLE IN LIVER DEATHS

Mann,[13] in a recent review of the physiology of the liver, remarks that the sympathetic nerves are present in the liver in great abundance; that they reach the liver by accompanying the hepatic artery and seem to be mainly for the purpose of controlling the blood flow through this artery.

The liver receives its sympathetic nerve supply from the celiac ganglion. This ganglion, in turn, receives its branches from the sixth to the twelfth thoracic segments of the spinal cord. The intercostal nerves involved at the thoracostomy operation arise from the sixth and seventh thoracic segments. Furthermore, the fibers of the intercostal nerves and of the sympathetic system emerge together in the anterior nerve roots, the sympathetic leaving the spinals later by way of the white rami communicantes. Thus it is evident that these two systems are closely related.

Mann further states "the arterial blood flow to the liver is under vasomotor control and is essential for the existence of the organ." Hence, stimuli received by the intercostal nerves could be relayed to the autonomic nerves innervating the hepatic artery, by way of the sympathetic fibers which take origin from the same cord segments.

If this happened the hepatic artery could undergo a massive and prolonged spasm as a result of "referred stimuli," producing a decided diminution in blood supply to the liver. It will be recalled that this patient's liver was already damaged by prolonged infection and the diminution in blood supply could easily institute necrosis of the liver.

Thus the conclusions which Boyce and McFetridge[2] arrived at, are fulfilled in this case—a damaged liver with the added strain of operation producing a toxin which is liberated into the blood stream.

The hypothesis here presented is offered as an attempt to fix the mechanism whereby "the strain of operation" affects the "damaged liver cells."

This is pure theory, unsupported by any clinical or experimental evidence. But if true, it would solve the problem of what causes "liver deaths."

CONCLUSION

This, and similar cases of extrahepatic "liver deaths" should crystallize our attention on the fact that "liver deaths" do occur after operations on other parts of the anatomy than the biliary tract; that in preparing patients for operation we should consider the possibilities of liver damage and give the patient a chance to build up a sufficient store of liver glycogen to withstand the rigors of operation. Also, where it is known that some degree of liver damage already exists, special care should be taken

to prevent "liver death" by conserving the glycogen reserve of the liver, especially by a more liberal use of intravenous glucose solution postoperatively.

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RUPTURE OF THE SPLEEN FROM MUSCULAR ACTION

REPORT OF A CASE

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IT is interesting to observe that the first recorded case of splenectomy, according to Krumbhaar[1] was by Zaccarelli of Naples in the year 1549. It is, also, of more than passing interest to know that the first case of splenectomy reported in this country was for injury due to a knife wound and was reported by O'Brien in 1816.[1] Since then there have been advanced and reported many causes of rupture of the spleen from spontaneous rupture of a normal spleen to that resulting from a very severe trauma or injury. While there has been more or less of a controversy as to the possibility of a normal spleen rupturing spontaneously, it has been reported by some writers and is now recognized as having occurred. Zuckerman and Jacobi,[2] in May, 1937, made an exhaustive critical study of the medical and surgical literature and found only twenty genuine recorded cases of spontaneous rupture of the spleen and seven questionable cases.

Bailey,[3] in 1930, reporting one case of spontaneous rupture of a normal spleen said, "Only the spleen can behave in this curious manner and from the practical standpoint there follows a good aphorism, 'In atraumatic hemoperitoneum in the male examine first the spleen.'"

One is impressed with the large variety of trauma that has produced a rupture of the spleen. The causes appearing most frequently were falls, pressure or compression, kicks or blows over the spleen, crushing injury, football accidents, and accidents from sledding and from "belly-flopping." In this modern age of automobiles and speed, the automobile is producing more ruptured spleens than any other one cause.

Muscular contraction with increased intra-abdominal pressure, fortunately, is a very rare and little mentioned cause of traumatic rupture of the spleen but one that must not be lost sight of. Susman,[4] in 1927, reported one case in which a man suddenly developed severe pain in the upper abdomen when he bent down to pick up a bucket of water. There was no history of any injury or blow prior to this date, although there was a history of flatulence and indigestion for the previous three months. Operation revealed a ruptured spleen and the patient died three days later. In 1933 Bohler[5] reported a case in which he believed muscular contraction and increased intra-abdominal pressure were responsible for the rupture of the spleen. A patient, in health, suddenly developed upper abdominal pain when bending over to pick up a heavy object. Operation revealed a ruptured spleen.

CASE REPORT

The patient had been sent to the hospital by his family physician with a diagnosis of acute appendicitis, but the internes on service thought he had a perforated gastric or duodenal ulcer.

The chief complaints were pain in the left upper quadrant and weakness. The family history was more or less negative. Father and mother had died of peritonitis. Three brothers and three sisters were living and well. The patient declared that he had never been sick, had never been operated on, and had never been injured.

About 8:30 A.M., while he was at work, he strained to pull a cable over a pulley in order to move or raise a heavy object and suddenly experienced severe pain in the upper left quadrant. He felt very weak and dizzy and had the sensation of fainting. He was cold, sweated profusely and his weakness and prostration increased. He was taken home and his family physician called. The latter diagnosed acute appendicitis and late in the afternoon sent the

patient to the hospital for operation. By this time the man had pain in his left shoulder.

The abdomen was tender and very rigid, but there was not a definite "boardlike" rigidity. Urinalysis was negative; the white count was 13,300 with 83 per cent polymorphonuclears. My first diagnosis, which later proved to be correct, was a ruptured spleen, but we were dealing with a very intelligent person who denied any injury whatsoever, and we therefore ruled this out and considered a presumptive diagnosis of perforated ulcer.

The man was operated on immediately, by way of an upper right rectus incision. At the opening of the peritoneum blood ran out. The incision was enlarged and the ruptured spleen palpated. It was necessary then to close the wound and remove the spleen through a left rectus incision.

Following operation the patient was given 300 c.c. of citrated blood. Except for an attack of bronchitis, recovery was uneventful. The patient was discharged on October 2, 1937. He was seen in the follow-up clinic on January 26, 1938 at which time he was symptom-free. His red blood count was 4,680,000, leucocytes 9,200, and platelets 612,000.

The pathologist's report of the removed spleen may explain the predisposing factor to the rupture of the spleen. The report gave the weight as 240 Gm. and showed, in addition to the traumatic rupture of the spleen and capsule, early chronic congestion. V. H. Moon[6] in a study of the variations of the size of the spleen from 2,000 specimens removed at autopsy stated that he did not consider a spleen pathologic that weighed less than 350 Gm., or rather he considered all spleens weighing 350 Gm. or over to be pathologic. Therefore, one would hesitate to call this specimen grossly pathologic. The congestion demonstrated histologically must have been a predisposing factor. Susman[4] states that Wohl points out that histologically the spleen ages early and believes that these early degenerative changes, softening of the spleen and congestion, are three causes that predispose to its rupture.

CONCLUSIONS

1. Muscular action plus increased intra-abdominal pressure may cause a spleen to rupture. One case is herewith reported.

2. This should be kept in mind to prevent making an error in diagnosis where the symptoms are suggestive of a ruptured spleen but the history is negative for injury.

3. When one encounters blood in the peritoneal cavity in the male, in the absence of trauma, examine first the spleen.

4. Kehr's sign, pain referred to the left shoulder, was present in this case.

5. Chronic congestion is, perhaps, a predisposing factor to splenic rupture.

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AMBULATORY TREATMENT OF FRACTURES OF METATARSALS IN BOTH FEET BY THE USE OF SPONGE RUBBER PADS

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IN fractures of the lower extremity, involving one limb only, patients can be made ambulatory with the aid of crutches, thus eliminating weight bearing on the injured limb. However, when both limbs are injured, getting about becomes either impossible or extremely painful, with the added danger of subsequent malunion or nonunion of the fragments. Enforced recumbency is not the most desirable method of treatment, nor is it the most satisfactory to the patient.

The writer was confronted with this problem recently, and has tried to solve it in the manner described herewith.

CASE REPORT

C. B., age 31, was seen December 22, 1937. Two days previous he had fallen from a step ladder and landed on the plantar surfaces of both feet.

Both feet were swollen and tender, on the plantar and dorsal aspects; weight bearing of the slightest degree caused excruciating pain.

X-rays taken the day of the accident showed a transverse fissure fracture through the neck of the middle metatarsal of the right foot (subperiosteal type) with no displacement or deformity. There was also a comminuted fracture of the head and neck of the second metatarsal with slight inward and dorsal tilting of the distal small fragments.

There were also transverse subperiostea fractures of the necks of the second and third metatarsals of the left foot, but with no displacement or deformity.

Recumbency and elevation of the limbs were advised to reduce the swelling. The feet were padded with sheet cotton and bandaged.

A week later the patient was feeling better, swelling was reduced, but weight bearing was still painful. It occurred to the writer that if the feet could be supported with the toes off the ground, it would reduce the stress on the fractured metatarsals to a minimum, yet enable the patient to bear weight on the posterior part of the feet.

Two bath sponges, one for each foot, about 6 by 3 by 1½ inches were shaped to fit the plantar surfaces of the feet and were held in place by figure-of-eight bandages, reinforced with adhesive strapping. The patient was comfortable, able to walk about the house, and, later, up and down stairs.

X-rays taken on January 26, 1938 showed firm exuberant callus formation around the fragment ends of the fractures of both feet. There was partial union of the fracture of the head and neck of the second right metatarsal with the same slight dorsal and inward angulation of the distal fragment. The fracture lines were faintly visible.

On January 29, 1938 the pads were removed and shoes padded within were substituted.

The patient returned to his regular occupation as a gasoline station attendant on February 14, 1938.

NEW INSTRUMENTS

A NEW SUPRAPUBIC BLADDER EVACUATOR*

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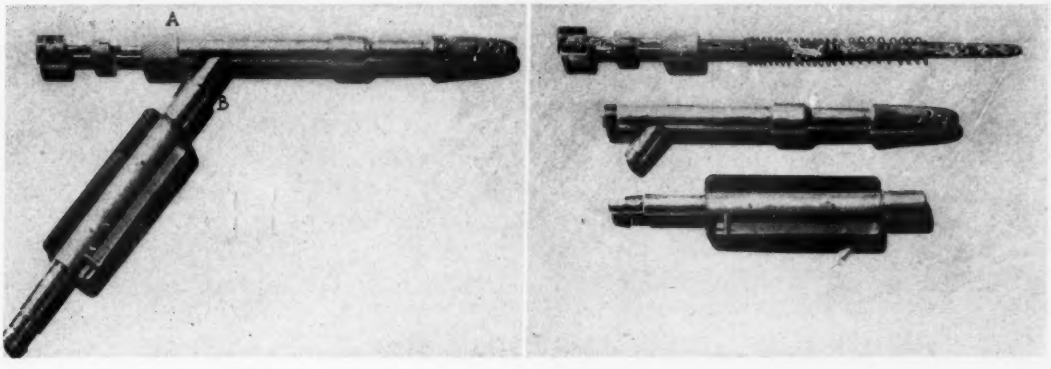
IN the operation of suprapubic cystotomy the operative field is often flooded by water and more or less infected urine when the bladder is opened. To obviate contamination from this source various types of trocars are made, some of which have been designed for bladder surgery, although most of them are instruments designed for general surgical use. All of them have some defects, and most of them seem to fail at the crucial moment. Because we were not satisfied with the existing instruments we designed a suprapubic bladder evacuator which we have used and found quite satisfactory.



A B

FIG. 1. Suprapubic bladder evacuator. A, assembled. B, taken apart for cleaning.

The principles of its construction are shown in Figure 1 and may be briefly summarized as follows:

1. A flat, adjustable knife blade which splits the bladder wall in a vertical direction, and is released by a spring as soon as the bladder wall is punctured.

2. An ovoid tip which follows the knife blade and rapidly divides the bladder wall.

3. Multiple openings in the tip which allow adequate suction even though the bladder wall may become adherent.

4. A raised collar against which the instrument is withdrawn as soon as the bladder is punctured which produces a water tight joint.

5. A pistol grip handle which allows the entire instrument to be manipulated with

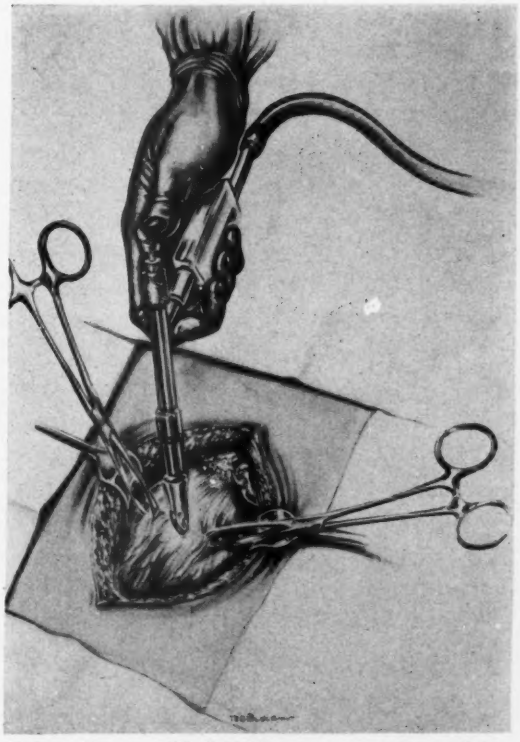


FIG. 2. Suprapubic bladder evacuator in position ready to puncture the bladder. Note that only one hand is necessary to manipulate the instrument.

one hand, including the thumb rest which operates the knife.

The instrument is easily dismantled for cleaning and oiling by taking it apart at points A and B. (Fig. 1.)

In using the instrument we have found that a well distended and exposed bladder, held firmly with two Allis clamps on either side of the point of intended puncture, gives sufficient resistance to secure a clean bladder opening. The active use of the instrument is illustrated in Figure 2. The bladder is rapidly evacuated when good suction is available, such as suction produced by a good water pump, or an anesthetist's pump which is kept in good repair. A non-collapsible rubber tubing should be used to insure prompt suction when the bladder is opened.

THE diuretic effect of the parathyroid hormone explains the polyuria and subsequent polydipsia of the hyperparathyroid patient which have been misinterpreted as signs of diabetes insipidus.
From—"The Endocrine Glands" by Max A. Goldzieher (Appleton-Century).

AN IMPROVED INSTRUMENT AND TECHNIQUE FOR INTESTINAL ANASTOMOSES*

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THE instrument here presented in improved form consists of three elements: a U-shaped spreading device operated by a thumb-screw and two identical clamps set in clips at either end of the tension device.

In order to clarify the employment of the instruments, its application to the intestines in a routine operation is described. (Figs. 2 and 3.) The gastroenterostomy, a typical example of enteroenterostomy, is used as a model.

The abdomen is prepared and the stomach approached through a high rectus incision. The desired folds of the stomach and jejunum are grasped with Allis tissue clamps placed about 5 inches apart. A piece of rubber dam tissue approximately 12 inches wide and 18 inches long is laid over the stomach and the long edge is applied to the fold of the stomach and held by Allis clamps. (Fig. 2.) The same procedure is followed with the jejunum.

The special small intestinal clamps are then fastened to the edges of the future anastomosis. The jaws of the clamp are opened by releasing the ratchet catch at the ends near the finger-rings. Thumbs and forefingers are inserted in the rings of the clamp, and the rubber-covered blade is placed in the center of the future anastomosis, with one side pressing against the stomach. The fold of intestine held by the Allis clamp is then gently drawn up between the center blade and the outside blade with the rubber insert. Pressure is brought on the ratchet catch so that it may securely retain the fold of the stomach. The loop of jejunum is guided into the space between the center blade and the opposite rubber insert, and fastened in the same manner. This procedure is repeated with the fold of stomach and jejunum on the opposite side. In this way, not only are the surfaces of the bowel afforded protection by rubber tissue, but they are also securely held in place at two opposed points.

The clamps are set in the holding clips on either end of the tension device and spread apart by turning down the thumb-screw. (Fig. 2.) This action draws the loops of stomach and bowel into a straight, tense line, and facilitates suturing. Allis clamps are now removed. Simultaneously, the application of tension in the two folds of bowel extenuates the mucous membrane within and creates a sphincter-like action. Such tension limits the amount of intestinal contents that may escape upon the rubber tissue in use against the folds of the anastomosis and forms a watertight protection against contamination of the general peritoneal cavity.

The two loops of bowel are firmly held together and the posterior continuous peritoneal suture is applied. The stomach is incised along and directly through the edge of the fold and into the lumen. Active bleeding from arteries and large veins is controlled by clamp and ligature. The procedure is repeated with the jejunum.

At this point, the seromuscular stitch is used. The particular advantage of this device is that it enables one to turn corners of the seromuscular layer with neatness, and renders it water-tight simply by releasing the large tension clamp on the anastomosis while the corner is being turned. The seromuscular stitch is com-

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pleted as usual and then the anterior peritoneal row of sutures is finished. The anastomosis is now complete.

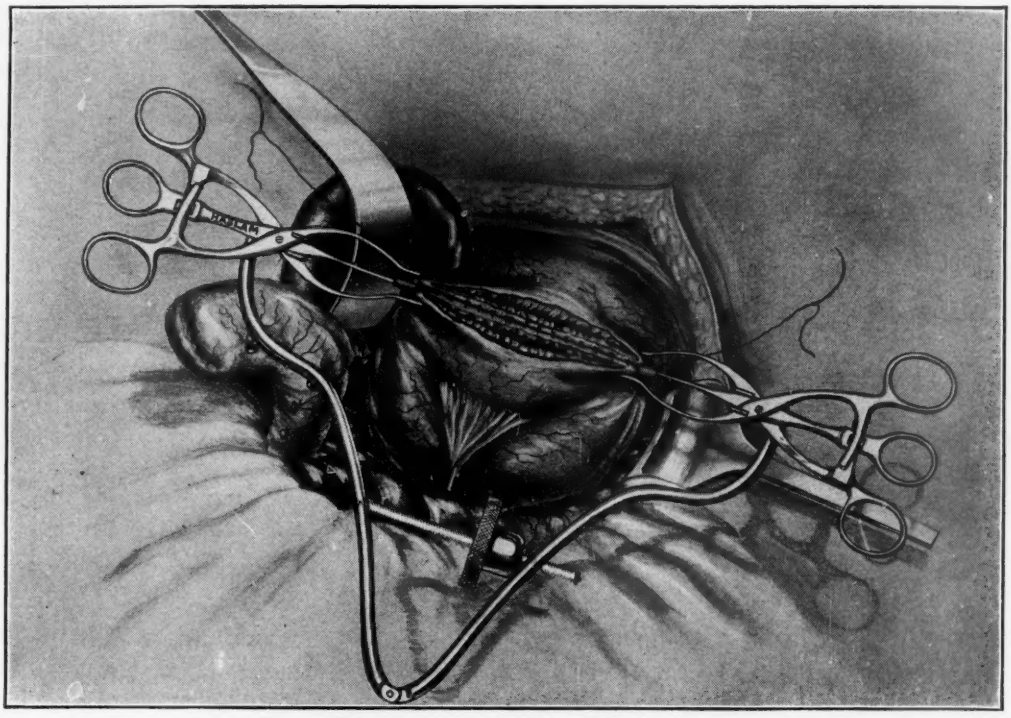

FIG. 1. The anastomosis of partial gastrectomy.

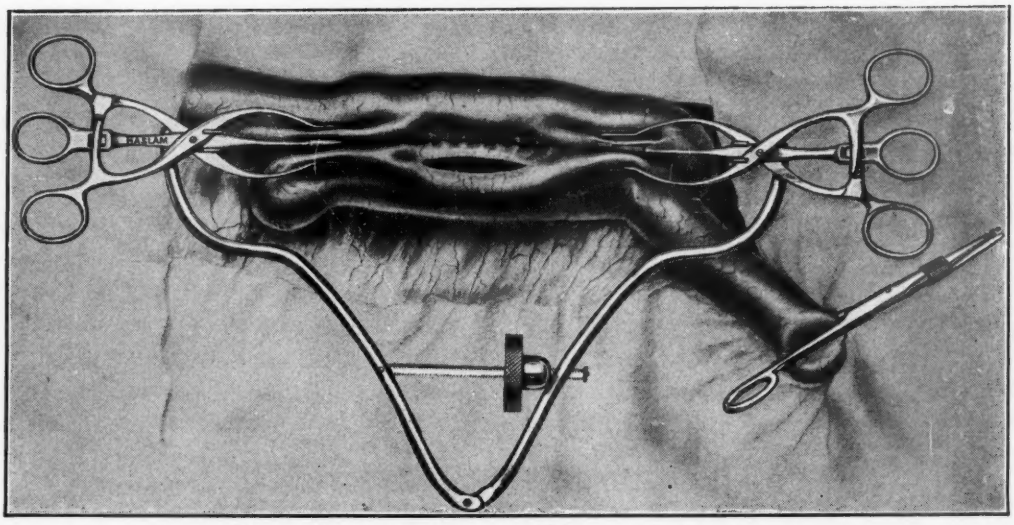

FIG. 2. Enteroenterostomy and/or gastroenterostomy.

The loops of the bowel may be wiped off with a mild aqueous solution of merthiolate. The gloves are changed, the clamps removed, and the rubber sheeting carefully lifted away. The abdomen may now be closed in layers in the usual manner without drainage. The general principles involved in anastomosing two loops of bowel together as outlined may be employed in any type of intestinal side-tracking method which may be desired.

In dealing with the obstructive lesions of the gastrointestinal tract due to carcinoma, hernia, adhesions, volvulus, and intussusception in which a resection must

of necessity precede the anastomosis, the technique is modified as follows: The segment of diseased bowel is removed in the usual manner. Before the clamps on the severed edges of bowel are removed, the intestinal contents are aspirated through a medium-sized trochar inserted into the free edge of the bowel at that point, approximately the middle of the anastomosis. The ends are closed over and the isomesenteric edges of the bowel are laid together and joined as described. As an alternative method to prevent the intestinal contents from escaping, we cut off the sharp points of a tonsil forceps, thread the sides with rubber tubing, and clamp the forceps on the proximal loop of bowel about 5 inches above the anastomosis.

The instrument and technique offer the following advantages: (1) accessibility of deep anastomosis is enhanced, as the bowel segments are properly aligned and set in the tension device (Fig. 1); (2) control of the anastomosis is secured by an adjustable tension screw which is of particular importance in the use of the Connell suture for watertight closure of corners in gastric surgery; (3) soft rubber tubing, spring inserts and adjustable positions on the notches make for a non-traumatic grip (Fig. 2.); (4) primary ligation of active bleeding vessels is secured; (5) the stoma is protected.

The last point is particularly important in view of the fact that failure of the stoma to function in the first few days after operation is a serious and sometimes fatal complication. We consider such failure a result of edema, a tissue response to the injury inflicted on the intestinal tissues and blood vessels by the prolonged application of the heavy clamps now in use. Many poorly functioning stomas are due to a technical error at operation—failure to prevent rotation of the jejunum on its long axis. A flap-valve effect results, manifested clinically by intermittent vomiting some time after eating. We have found that this error may be prevented by suturing the various layers of the anastomosis under exactly regulated tension throughout the entire procedure. (Fig. 3.)

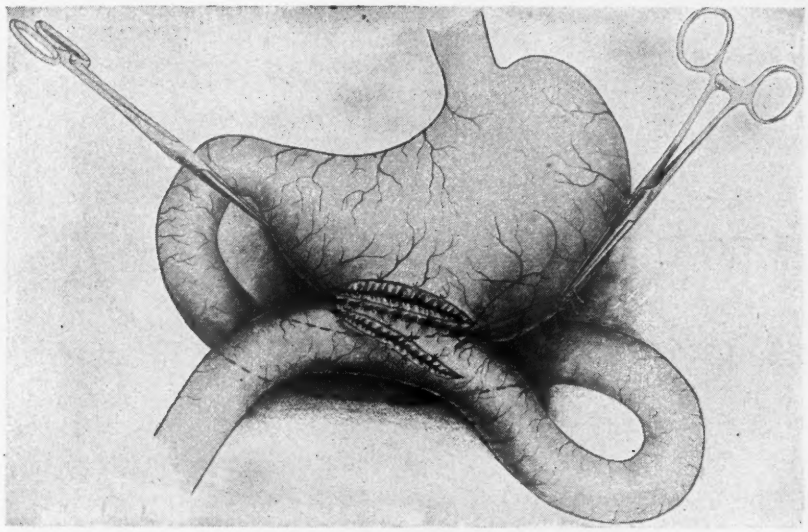

Fig. 3. Gastroenterostomy showing twisting of jejunal stoma from an axis parallel to gastric stoma.

With individual variations in technique and the preparation of the patient, the clamps may be used in performing all types of gastric operations including the Billroth modifications. Enteroenterostomies and enterocolostomies may also be performed safely with a minimum of shock and hemorrhage when preceded by gastric lavage and cleansing enemas.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

OBSTETRICS IN COLONIAL AMERICA*

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IN the new world, the seventeenth century was one of struggles and beginnings. The settlement of Jamestown in 1607, of Plymouth in 1620, and of New Netherlands in 1623, was accomplished only in the face of great suffering and privation. Frontier conditions existed everywhere. By the close of the century only three or four generations had been born along the Atlantic seaboard. The white race had secured a mere foothold on the Eastern landfall of a vast continent. In front was a wilderness and the lurking Indians, behind stretched three thousand miles of sea.

For the colonial mother the vicissitudes of a pioneer existence must have been especially trying. She established a home in a strange land with a rigorous climate. Children came in quick succession but many died during the first few weeks of life. Each year inevitably brought a new life and if the newborn was of the same sex as the one just lost he or she received his or her given name. Such names as Thankful and Patience were significantly common.

The care given to women in childbirth was almost entirely in the hands of women. The only reference found of a man taking part in midwifery during the century is to be noted in a letter written by Samuel Lee of New England in 1690 to Nehemiah Grew of London. He wrote: "I knew one Doctor Avery since deceased, a man of pretty ingenuity who from the ars veterinaria fell into some notable skill in physick and midwifery & invented some useful instrumts for that case." This was Doctor William Avery of Dedham and Boston who died March 18, 1687, at about 61 years of age. The instruments referred to were probably devised for the removal of a dead child since at that time the forceps were the family secret of the Chamberlens.

The names of many of the early colonial midwives have come down to us. Among these Anne Hutchinson's is the most notable. She was banished from Boston by the religious leaders because of radical views. She went to Rhode Island for a time and finally to Pelham in Westchester County where she and her family were massacred by the Indians during a raid. Her name is perpetuated in the Hutchinson River Parkway.

Ann Eliot, wife of the apostle to the Indians, practiced midwifery. Her tomb, erected by the town of Roxbury, Massachusetts in 1687, bears the legend, "She was thus honored for the great service she hath done this town." The grandson of the

* Read before the Section on History of Medicine, Medical Society of the County of Kings, May 13, 1938.

apostle, Jared Eliot of Connecticut, was a noted pastor-physician famous for his sermons. One of these he preached on the death of his mother-in-law, Elizabeth, a midwife of Guilford. "She knew," he said, "when to exert herself vigorously and also when it was her strength to sit still."

In New Amsterdam midwifery was also in the hands of women. In 1660 the town council voted Hellegond Joris, town midwife, a salary of one hundred guilders ($40) a year for attending the poor of the city.

In the south each plantation had its own midwife. Negro midwives attended white women as well as negroes. In Surry County, Virginia, in 1685, the fee of Goodwife Thorpe, midwife, was 100 pounds of tobacco. Agnes Williams paid the Widow Hollens a dozen hens for attending her in confinement.

The only publication of any obstetrical significance printed in America during the seventeenth century was a reprint of a little book published in London in 1663. It illustrates exactly the sad state of midwifery at the period both here and abroad. The title reads: *A Present to be given to Teeming Women by their Husbands or Friends containing Scripture-Directions for Women with Child, how to prepare for the hour of Travel.* The author was John Oliver and the book was reprinted at Boston, by Benjamin Harris in 1694. Aside from some superficial advice to the pregnant woman on the care of her own health by avoiding excesses there is nothing of a practical nature. The bulk of the work deals with the duties of pregnant women which consisted of prayer, repentance, reading of scripture, meditation, resignation and preparation for death.

The genealogical records and old gravestone inscriptions bear mute testimony to the fact that childbirth in colonial America was accompanied by a frightful mortality for mothers and infants. Alice Morse Earle wrote: "It is heart-rending to read the entries in many an old family Bible—the records of suffering, distress and blasted hopes. There lies before me an old leather bound Bible with the records of my great grandfather's family. He had sixteen children. When the first child was a year and one half old the second child was born. The baby was but four days old when the older child died. Five times did that mother's heart bear a similar cruel loss when she had a baby in her arms; therefore, when she had been nine years married she had one living child, and five little graves bore record of her sorrow."

Many similar records could be found. Cotton Mather had fifteen children, only two of whom survived him. Judge Samuel Sewell recorded the birth of fifteen children in his famous diary. He buried two wives. The death of his daughter is recorded three days after the birth of her first child, the cause probably being infection.

The early midwives practiced internal podalic version, for Jane Hawkins, who delivered Mary Dyer of a monstrosity which caused a great disturbance among the New England witch hunters, testified in regard to the case that the baby "which was of ordinary bigness, came hiplings till she turned it."

An attempt was made to regulate the practice of medicine including obstetrics as early as 1649, in Massachusetts. A similar enactment was passed in New York in 1674. For the most part the treatment of the colonial mother was stark neglect or at best the meddlesome interference of ignorant grannies in whose hands she fared worse than the Indian squaw. Men's eyes were turned heavenward. The dangers of the invisible world loomed larger than the dangers of childbirth. Motherhood was just another tribulation in a sorrowful and suffering existence.

The eighteenth century brought great changes. Obstetrics in Europe advanced to a more scientific position than any other practical branch of medicine. The basic cause was a social evolution characterized by the growth of the democratic ideal and upsurge of the humanitarian spirit. The infant welfare movement emerged. When knowledge of the obstetric forceps became

available about 1773, physicians gained entrance into the lying-in chamber. They began to realize that to preserve infants more attention should be paid to the birth process. "In the nurture and management of infants as well as in the treatment of lying-in women," wrote Lettsom in his Medical Memoirs in 1774, "the reformation hath equalled that in the smallpox; by these two circumstances alone increditable numbers have been rescued from the grave."

The population of the colonies at the beginning of the eighteenth century was about 300,000. By the middle of the century enough capital had been accumulated and enough leisure acquired to enable a fairly large group of young colonials to cross the seas and contact the main current of medical learning at Leyden and London and Edinburgh. They brought back a leaven which accelerated the rapid rise of American medicine. Among those who went abroad to study were James Lloyd, the earliest practitioner in New England to specialize in midwifery. He studied under William Hunter and William Smellie. Lloyd was a great teacher of obstetrics and had as his pupils in Boston such men as Oliver Prescott, Isaac Rand and Marshall Spring. That the efforts of Lloyd and his pupils to establish obstetrics as a branch of medical practice met with success may be inferred from the following advertisement from the Boston Evening Post of November 10, 1781:

"The physicians of the town of Boston, hereby inform the public, that, in consideration of the great fatigue and inevitable injury to their constitution, in the practice of midwifery, as well as the necessary interruption of other branches of their profession, they shall, for the future, expect that in calls of this kind, the fee be immediately discharged."

The most notable student of Hunter and Smellie was William Shippen, Jr., who returned to Philadelphia in 1762 and immediately announced a course of lectures which included a few plain general directions in the study and practice of midwifery. The next year he gave a full course of lectures on obstetrics, the first in America. Philadelphia took the lead in obstetrics for a great many years. At the Philadelphia Alms House was established what Agnew considers the first obstetrical clinic. As early as 1770 and possibly earlier, Dr. Bond and Dr. Evans personally instructed students who were allowed to attend cases of labor. At the Pennsylvania Hospital Dr. Bond commenced clinical lectures upon midwifery as early as 1766 but the lying-in ward was not opened until 1807.

In New York City, the first professorship devoted solely to obstetrics was established in 1767 at Kings College (later Columbia), with J. V. B. Tennent as the first professor. In Philadelphia, Shippen held the combined chair of Surgery, Anatomy and Obstetrics in the University of Pennsylvania in 1792. There was no chair of obstetrics at Harvard University until 1815.

After the Revolutionary War Samuel Bard gave a private course of lectures on obstetrics, the medical school being disorganized. In 1799 a lying-in ward was established in the Almshouse of the city of New York. The same year Valentine Seaman gave lectures at the Almshouse on midwifery, to women exclusively. The fact has never been brought out that the earliest clinical teaching of medicine in New York City was given at the Almshouse which later became Bellevue Hospital. The New York Lying-In Hospital began as a direct result of the terrible mortality from the yellow fever in the summer of 1798 "when many women were bereaft of their husbands." David Hosack was responsible for the establishment of the hospital which was incorporated in 1799.

In 1789, George Buchanan of Baltimore delivered a course of lectures on the diseases of women and children to a class of nine students and at the same period Andrew Wiesenthal lectured at

his own house on anatomy, physiology, pathology, operative surgery and the gravid uterus. During the succeeding winter Dr. Buchanan also delivered a course of lectures in midwifery. Buchanan attempted to found a lying-in hospital but failed.

The obstetrical literature of the period was, of course, derived from the teachings of the great British obstetricians of the eighteenth century. In 1786, *An Abridgement of the Practice of Midwifery and a set of Anatomical Tables* by William Smellie was reprinted in Boston. This work was the first illustrated medical book we have and also contains the first illustration of the obstetrical forceps to appear in this country.

Another great classic reprinted here in 1793 was Charles White's *Treatise on the Management of Pregnant and Lying-in Women*. Excellent prophylactic rules for puerperal fever were laid down. White instituted the principle of uterine drainage by placing his patients in a sitting position shortly after delivery. He was an advocate of antiseptic injections into the uterus for the removal of putrid matter. He taught the necessity of absolute cleanliness in the lying-in chamber and urged the isolation of infected patients.

A second type of literature appearing at the time should not be overlooked, namely, student theses. Space will permit the discussion of only one—*A Dissertation on the Puerperal Fever* delivered by Peter de Sales la Terriere, a Canadian student at Harvard. This was printed in Boston in 1789. Significant is his statement that: "The numbers cut off by this disease in Canada have moved my compassion." Discussing treatment he speaks of "An ingenious practitioner of eminence in this commonwealth" who "recommended an antiseptic course," and who "under appearances actually putrid prescribed antiseptics."

The earliest contributions to periodical literature were of necessity printed in London publications. Early operations for advanced extra-uterine pregnancy were reported by John Bard in 1762 and Charles McKnight in 1795. An early report, hitherto overlooked by historians, was made by William Baynham of Virginia in 1791 and published in the first volume of *Medical Facts and Observations*, London, 1791.

In the closing years of the century a number of contributions on obstetrical subjects were printed in this country in works of a periodical nature. Leverett Hubbard contributed a paper on deformed fetus to the first volume of *Transactions*, published by the Medical Society of New Haven County in 1788.

The medical papers communicated to the Massachusetts Medical Society contained at least seven contributions on obstetrics. Tragic indeed is *An Account of a Case of Ruptured Uterus* by Oliver Prescott. The patient had regular pains for eighty-two hours. The head was unengaged, for the pelvis was contracted. Several doctors were in attendance to attempt instrumental delivery when the cervix became dilated, but before this occurred the woman died. Autopsy revealed a ruptured uterus.

More courageous was Jesse Bennet, a country practitioner in the Valley of Virginia, in the case of his own wife. He performed cesarean section, saving mother and child. This was the first successful cesarean in America.

Dr. Thomas Archer of Harfordtown, Maryland, reported a singular case of difficult parturition successfully treated in 1797. He had watched the case for a long time and labor failed to progress. Finally he decided to act. We quote his words: "Unknown to the patient or any of the attendants except the midwife, who held the candle (for it was now night), with a common spear-pointed lancet, I made three incisions in the neck of the womb, which was very much distended; each about two inches in length, viz., one from the uterus leading toward the urethra, one toward the perineum; and the other toward the labium." The patient was then delivered and was up and about three weeks after.

At the close of the colonial period considerable progress had been made in obstetrics. The religious and mystical phase of the seventeenth century had given way to a more rational and objective approach. No great contributions had been made, but highly important beginnings. Obstetrics had found a place in two medical colleges. Lying-in wards had been opened and some clinical teaching commenced by men with really excellent training. Classic British works on obstetrics had been reprinted. The forceps had been introduced. Contributions by American physicians had begun to appear. Cesarean section had been successfully performed as well as several operations for extra-uterine gestation. This advance was to be accelerated in the nineteenth century and prior to the introduction of asepsis and antisepsis carry with it a tremendous price in the ravages of puerperal infection. Nevertheless, the era of blistering, purging and blood-letting was passing away.

THE most striking new fact clearly demonstrated in respect of the urinary excretion of prolan (in pregnancy) is that an enormous excretion is observed about the 50–60 day following the last menstrual period . . . The highest figures reported are 100,000 to 300,000 rat units per liter of urine in comparison with a later fall to about 3,000 rat units per liter.
From—"The Physiology and Pharmacology of the Pituitary Body" by H. B. Van Dyke (University of Chicago Press).

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